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Mental and physical distress of field veterinarians during and soon after the 2010 foot and mouth disease outbreak in Miyazaki, Japan

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Summary

An outbreak of foot and mouth disease occurred in Miyazaki, Japan in April 2010, and nearly 290,000 animals were culled to control the disease. This study was conducted to demonstrate the causes and intensity of mental distress encountered by the field veterinarians participating in the control programme.

A focus group discussion was conducted with ten veterinarians to understand their distress during the outbreak, and a questionnaire to quantify the degree of distress experienced each week was administered to 16 veterinarians. A detailed questionnaire was separately administered to 70 veterinarians six months after the outbreak was controlled, to assess mental distress status and to identify the risk factors for serious mental illness (SMI) using the six-item Kessler scale (K6).

Overall, mental distress (mean 3.1) was significantly greater than physical distress (mean 1.9, $p < 0.001$). The risk factors for mental distress were categorised into three groups: culling, communication with farmers, and gender; each category was qualitatively described. Only two respondents (2.9%) had high K6 scores suggesting SMI. In the final generalised linear models with quasi-Poisson errors, the risk factors for SMI that remained were: disinfecting vehicles ($p = 0.01$), distress ($p < 0.001$), and increased alcohol consumption ($p = 0.057$), and a protective factor: participation in culling ($p = 0.07$), which suggested healthy worker bias. Sensitive individuals had been allocated to non-culling activities during disease control.

In conclusion, human resource management was adequate during the outbreak from a public-health perspective. However, monitoring delayed symptoms of post-traumatic stress disorder is recommended.

Keywords

Culling – Foot and mouth disease – Japan – Mental health – Miyazaki – Veterinarian.

Introduction

On 20 April 2010, an outbreak of foot and mouth disease (FMD) occurred on a beef cattle reproduction farm in Miyazaki, Japan (Fig. 1). There are seven known serotypes of FMD virus: O, A, C, SAT 1, SAT 2, SAT 3 and Asia 1. Immunity induced by one serotype does not protect against infection by another (1). Pigs are raised in much higher numbers than cattle and, per animal, they can excrete more airborne virus than cattle (2, 3). Unfortunately, pig herds were infected on 28 April in Miyazaki and culling animals on infected farms did not stop the outbreak. In Miyazaki, the relative infectiousness of a pig herd was estimated to be eight times higher than that of a cattle herd (95% CI: 5.0–13.6) (4). Emergency vaccination was implemented using the O-type vaccine, O1-Manisa, between 22 and 26 May for 126,000 animals on 1,066 farms (5). By the time that the final outbreak ended on 4 July, a total of 292 outbreaks had been confirmed, and 288,649 vaccinated and unvaccinated animals on 1,304 farms had been culled (6).

Experiences during FMD outbreaks in the Netherlands and the United Kingdom (UK) in 2001 show that culling animals to control FMD affects the mental health of farmers, and there is evidence from quantitative epidemiological studies that this is the case (7, 8). However, no research studies have directly addressed the psychological consequences of the FMD outbreak for veterinary surgeons in the UK (8). In the Netherlands, a few studies on the mental health of veterinarians involved in an FMD outbreak have been published, although not in English (9, 10). A risk factor for traumatic stress two years after the FMD outbreak was having been threatened either physically or verbally during the crisis (9), and 40% of the veterinarians involved in disease control still showed signs of a traumatic stress reaction six years after the outbreak (10). Post-traumatic stress disorder (PTSD), which has three symptom dimensions: intrusion (for example, nightmares or flashbacks of the trauma), avoidance (deliberate efforts to not think or talk about the event), and hyperarousal (such as disturbances in sleep, hypervigilance, and angry outbursts) (11). People who experience

symptoms of PTSD as a result of actively participating in traumatic events are said to have perpetration-induced traumatic stress (PITS) (12). PITS has been identified in veterinarians who participate in the killing of healthy animals, which threatened their identity as a veterinarian (12, 13). In the UK FMD outbreak, veterinarians felt that farmers found it easier to talk to them rather than to community caseworkers or government staff for emotional support (8, 14). Hall *et al*. (14) warn of the susceptibility of veterinarians to traumatic stress, due to over-dedication, exhaustion and burn out.

In Japan, throughout the outbreak, Miyazaki Prefecture provided physical health check services at municipal offices every morning for veterinarians and animal technicians participating in culling. In June 2010, the Miyazaki Prefecture Centre for Mental Health and Welfare (MPCMH) began monitoring the mental health of 1,300 farmers. These mental health checks were carried out by nurses over the phone, because if they had visited the farms in person they may have contributed to the spread of FMD. A year after the outbreak, in 2011, a collaborative research team was formed comprising psychiatrists, a psychiatric epidemiologist, field veterinarians and a veterinary epidemiologist. The objective of the team was to analyse the mental health status of farmers, veterinarians and local residents in order to find ways to meet their needs and help them access public and mental health resources, and to provide data for better policy support.

From a public-health perspective, disaster management experts do not yet pay enough attention to FMD globally. One Health, a multisectorial approach involving human and animal health and environmental sciences, offers global solutions to zoonoses control (15); however, there is currently little collaboration between psychiatry and veterinary medicine. This paper presents findings on the mental health distress of local veterinarians during and soon after the end of the FMD outbreaks in Miyazaki in 2010. The data were obtained by this new multisectorial collaboration, with a combination of qualitative and quantitative approaches. This paper focuses on the distress of veterinarians; the information collected on the mental health of farmers and local residents will be published at a later date.

Materials and methods

Participatory epidemiology

A focus group discussion with one facilitator and ten field veterinarians was conducted in May 2011 in Miyazaki. Eight of the veterinarians came from the Veterinary Clinical Centres of the agricultural mutual relief association (AMRA) located at the epicentre of the FMD epidemic (there are a total of four AMRAs in Miyazaki Prefecture), and two of the veterinarians came from the Veterinary Clinic and Training Centre of the Miyazaki Prefectural Federation of Agricultural Mutual Relief Associations (F-AMRA), which is the body which oversees the AMRAs. Two of the ten field veterinarians were in the second year of their career, four were at mid-level and four were at the supervisor level. Only one female veterinarian, who was at mid-level, was included in the study. Two sessions of 60 minutes each were conducted in one day. Participants were encouraged to mention the causes of mental distress, and either the participants or the facilitator recorded the causes on sticky notes so that they could be referred to while discussions were in progress. After two sessions, the sticky notes were categorised into groups and these categories were named following the consensus of the participants. These causes were then entered into a database and narratively described.

Modified seasonal calendar analysis

Seasonal calendar analysis, a technique used in participatory epidemiology (16), was conducted in conjunction with a questionnaire survey. Based on comments from the focus group discussion, a short questionnaire was developed to assess mental and physical distress on a 0 (no distress) to 4 (high-level distress) Likert scale. The survey covered the 11 weeks from 20 April to 4 July 2010. The questionnaire was tested and given to 16 veterinarians, including five supervisors, in September 2011. Although the data were Likert scales, arithmetic means were used in presenting the transition in the level of distress. Confidence intervals based on the normal distribution were calculated to show variance, because it was considered that a pleasant situation would give a score below 0 and that the score could go above 4 when

the veterinarians suffered greater distress than thought to be the maximum. The means and confidence intervals were calculated for the purpose of presenting the level of distress, not for statistical analysis. For the comparison between mental and physical distress and comparison of these types of distress between different weeks, the scores for each person during each week were matched and the Wilcoxon matched-pairs signed-rank test was performed using the statistical software package R 3.0.2.

Questionnaire survey of mental health

A questionnaire was distributed in January 2011 to the field veterinarians in F-AMRA, AMRAs and private veterinary clinics who participated in controlling the FMD outbreak. The questionnaire was returned to MPCMH by mail. It was not administered to veterinarians employed by the Miyazaki Prefectural Government.

The survey included questions about age, gender, period of activity (days), hours per day of activities, rest time, health and changes in habits. The Wilcoxon rank-sum test was performed to compare the number of days off, as these data did not follow a normal distribution. The six-item Kessler scale (K6) scores were collected to screen for serious mental illness (SMI), using a cut-off point (K6 > 13) suggested by Kessler *et al.* (17). The Japanese translation of questions for the K6, which was validated (areas under receiver operating characteristic curves: 0.94; 95% CI: 0.88–0.99) through back translation (18), was used in the present study. Risk factor analysis for high K6 scores was conducted for all variables. After univariate analysis, the factors with a *p*-value less than 0.2 were checked for co-linearity (one of the two variables with correlation coefficient $r > 0.8$ was chosen) and entered in the multivariable generalised linear models (GLMs) with quasi-Poisson errors; the K6 score was chosen as the outcome variable, as the data were overdispersed. Step-wise model simplification (19) was performed to find risk factors for SMI.

Results

Temporal changes in the causes and intensity of mental and physical distress

Figures 2 and 3 show the causes and intensity of the perceived mental and physical distress of field veterinarians and supervisors as the control programme progressed. The causes of distress in these figures were reported in the focus group discussion, and were presented along a timescale in the seasonal calendar analysis. On 20 April 2010, 20 days after the first suspected case of FMD in a water buffalo on 31 March (4), a sample from cattle at a beef cattle breeding farm in Tsuno-cho, Miyazaki Prefecture, tested positive for FMD virus by reverse-transcription polymerase chain reaction (RT-PCR). F-AMRA and the AMRAs immediately stopped veterinary clinical services on that day. The following day, RT-PCR confirmed the second infected premise (IP), a dairy/beef mixed farm in Kawaminami-cho – a town that was severely affected by FMD. In Japan, animal disease control is conducted by veterinarians at the Prefectural Livestock Hygiene Service Centre. After the report of the sixth confirmed IP on 23 April, field veterinarians at F-AMRA and the AMRAs, who were very familiar with the geography of the area, realised that FMD had already spread over a wide area before the first confirmed case had been reported. F-AMRA and the AMRAs immediately proposed a joint culling programme for the Miyazaki Prefecture to increase the capacity in the field, but the prefecture officers refused. On 28 April, the first confirmed IP among pig farms (10th IP) was reported, which suggested a higher risk of further spread due to the high dose of virus excretion from pigs. Joint culling was repeatedly proposed until it was accepted on 3 May, by which time FMD had spread to four pig farms. During these two weeks, while physical distress remained low (0.6 to 0.5), the mean mental distress score of field veterinarians increased from 2.4 to 3, because the field veterinarians were not yet able to directly help the livestock industry cope with the FMD outbreaks. During the third week, veterinarians from other prefectures began to be sent to Miyazaki Prefecture. The mental distress of supervisors during this time showed the highest score (3.6) because they were

anxious about planning a countermeasure with limited information and felt sympathy for the farmers.

During the third week, on 4 May, field veterinarians were dispatched to large-scale pig farms to start culling, and established an animal welfare-friendly method using euthanasia after injection of sedative (animal welfare was not necessarily achieved by some of the groups of veterinarians and non-veterinarians from different private and public organisations in and outside Miyazaki Prefecture, especially when they lacked skilled veterinarians). Mental distress among veterinarians again increased to 3.4 and the causes of distress were confusion related to unfamiliar tasks and anger about the mismanagement of the initial response and hygiene control, which might have exacerbated the spread. Command systems were chaotic, because several task forces were established at different administrative levels. Physical distress sharply increased to 2.2 as a result of culling without any days off (Week 2 versus Week 3, $p = 0.03$). The distress levels of supervisors were continuously high (3.6) due to worry about the health of field veterinarians.

During the fourth week, shift work (three days on, one day off) was introduced and the efficiency of culling as a team increased. However, the outbreak proceeded faster than the animals could be culled and the veterinarians felt helpless. Both physical and mental distress levels remained high (2.6 and 3.4, respectively), and veterinarians frequently experienced insomnia and nightmares.

During the fifth week, on 19 May, the Japanese Government ordered the use of vaccine and the culling of all vaccinated animals. The veterinarians despaired, knowing that all farms in the areas would lose all of their animals. The number of live animals in infected and vaccinated farms which had to be culled kept increasing and reached a peak (68,546) on 23 May, at which point the mental distress of veterinarians reached its highest point (3.5). The supervisors had to organise emergency vaccination teams using veterinarians who were not working at the IPs, and had to explain to AMRA member farmers

about compensation. The mental distress of supervisors was highest (3.6) in the sixth week.

During the seventh week, physical distress increased due to hot temperatures (means of the mean, maximum and minimum temperatures in June 2010: 22.3°C, 25.4°C and 19.5°C, respectively [20]); veterinarians had to wear rubber boots and disposable protective suits during these hot weather conditions. However, mental distress decreased with the decrease in the number of animals to be culled (Week 6 versus Week 8, $p = 0.02$). During the eighth week, field veterinarians started to receive telephone calls from their old veterinary school classmates, which further relieved their distress. Their friends had delayed calling so as not to distract them from their FMD control activities.

During the 11th week, after culling was over, the physical distress of veterinarians decreased (Week 10 [2.3] versus Week 11 [1.3], $p = 0.05$) but mental distress did not (2.6 versus 2.9, $p = 0.3$), because of the realisation that none of the farms in their areas had any animals left. The mental distress of supervisors remained high due to contentious discussions with farmers about the differences in the compensation arrangements for IPs and for vaccinated farms. As this was the first time that the FMD vaccine had been used in Japan there was no legislation to regulate compensation for vaccinated farms and so compensation was delayed until the passage of the Act on Special Measures concerning Measures against Foot and Mouth Disease (21).

There was consistently a variety of different levels of physical distress among supervisors because of the variety of their work; supervisors even sometimes participated in the culling. Overall, mental distress (mean 3.1) was greater than physical stress (mean 1.9, $p < 0.001$) for both field veterinarians and supervisors. In a comparison of only field veterinarians, mental distress (mean 3.1) was again greater than physical stress (mean 2.0, $p < 0.001$).

Qualitative descriptions of mental distress

Box 1 shows the three categories of causes for the psychological difficulties reported in the focus group discussion: culling, communication with farmers, and gender difference. A veterinarian who had graduated one year earlier was shocked to realise that he had killed a much higher number of animals than he would ever be able to save in the rest of his career. This was a painful realisation, as he had been motivated to become a veterinarian to save the lives of animals. While many different types of distress associated with culling were described, there were two factors that relieved the distress: health checks every morning, and support from the veterinarians dispatched from other prefectures, central government, and the Self Defense Force. The distress which came from communication with farmers mostly resulted from their sympathy for them. During the cull, supervisors were concerned about the long hours veterinarians were working to maintain culling efficiency. The supervisors were not sure whether they had been right to decide not to send female veterinarians into the culling environment because of the lack of separate changing facilities. Female veterinarians, however, participated actively in vaccination. Supervisors mentioned that veterinarians who were sensitive and did not disclose their feelings tended to deal poorly with the distress, but they also said they wondered whether they were able to detect such characteristics.

Questionnaire survey results

A total of 81 questionnaires were returned to MPCMH, and 70 of the respondents had participated in FMD control activities. Out of those who participated, 62 (88.6%) were male and eight (11.4%) were female. Twelve respondents (17.1%), including two females, belonged to private clinics, two belonged to F-AMRA and the remaining 56 respondents (80.0%) worked for AMRAs. F-AMRA and AMRA respondents included only one veterinarian in a directorial post.

Foot and mouth disease control activities

Table I shows the different FMD control activities in which the respondents engaged. The most common task was culling (41 respondents, 58.6%), then emergency vaccination (21, 30%), followed by clinical examination of animals for disease detection to confirm the absence of FMD (15, 21.4%). Culling was the most intensive task in terms of the days attended per month (average 12 days, with a maximum of 26 days) and 65.8% of respondents engaged in culling for more than 8 hours per day. Vaccination was the most common activity for female veterinarians (gender ratio 4.3, male 17 versus female 4).

Rest time

Table II shows the rest time that veterinarians were able to take during the busiest months. The mean hours of sleep and days off per month were calculated for the months that the respondents chose as the busiest: the greatest number of respondents considered June to have been the busiest month (32/62, 51.6%), and the second greatest number chose May (16, 25.8%). The mean hours of sleep were similar and the ranges overlapped; statistical analyses were not performed. Generally, respondents reported less than 8 hours of sleep, and some respondents obtained only 4 hours of sleep during stressful situations. One veterinarian in a private clinic only participated in vaccination. When the data for this individual veterinarian were removed, the mean number of days off in May became 7.9 (range: 1–10).

Combining data for May and June, and July and August, the number of days off in May and June (mean 7.0) was significantly higher than those in July and August (mean 5, $p = 0.05$); this might be due to shift patterns during culling and the fact that private veterinarians stopped clinical services to prevent the spread of disease.

Health problems encountered during FMD control

Table III shows the health problems encountered during the FMD control effort. Out of 70 respondents, 65 provided answers to the

questions concerning health, of which 64 (98.5%) reported having at least one of the problems. The most common issue was fatigue (25/65, 38.5%), followed by needle-stick injuries, foreign substances in the eye(s), dehydration and insomnia, all of which were reported as problems by 14 respondents (21.5%). The symptoms that are frequently associated with mental distress, such as fatigue, insomnia, stiff shoulders, headache, anorexia, stomach ache, dizziness, difficulty concentrating, hardness of hearing and nausea, were common.

Health status six months after the final containment of the outbreak

At the time of the survey (January 2011, six months after the final containment of the disease in July 2010), 23 (33.3%) of 69 respondents reported health problems. The most common symptoms were fatigue and stiff shoulders (10 respondents each, 10/69, 14.5%), followed by cold-like symptoms, i.e. nasal congestion/runny nose (6, 8.7%) and cough/phlegm (5, 7.2%) (Table IV). Common symptoms of mental distress such as fatigue, stiff shoulders, dizziness, insomnia, irritability, tinnitus, palpitations, heartburn and anorexia were dominant. The respondents categorised their general health condition as good (21/69, 30.4%), fair (22, 31.9%), usual (19, 27.5%) and not so good (7, 10.1%) (data not shown in the Tables).

Mental distress six months after the final containment of the outbreak

Out of 70 respondents, 39 (55.7%) reported feeling distressed six months after the outbreak had been contained. The most common cause of distress was their job (24/70 responses, 34.3%), then their household finances (11, 15.7%), followed by non-family relationships (10, 14.3%) and the education of their children (9, 12.9%) (Table V). As so many animals had been culled, F-AMRA, AMRAs and private clinics lost a source of income, which was probably the root of their job- and finance-related problems. Culling may have also affected relationships between colleagues and farmers.

The majority of respondents with distress had somebody to listen to them (30/38, one did not provide the answer, 78.9%). The people that they talked to were: family members (23/38, 60.5%), friends (17, 44.7%), supervisors (7, 18.4%) and professional psychiatrists (4, 10.5%, data not shown in Tables). No respondent used public institutes such as health centres or the MPCMH.

Changes in habits compared with before the outbreak

The majority of respondents who had gambled and consumed alcohol and caffeine before the FMD outbreak did not change their habits after the outbreak (Table VI). Among the small proportion of respondents who did change their habits, those who reduced the frequency of their alcohol consumption and gambling were more numerous than those who increased the frequency of their habits. However, those who increased the frequency of caffeine consumption were more numerous than those who decreased their consumption.

K6 score

Out of 70 respondents, only two (2.9%) exceeded the cut-off value of the K6 score, suggesting SMI (16). Table VII shows the results of univariate analyses using GLMs with quasi-Poisson errors (dispersion parameter 4.9). The factors with a *p*-value less than 0.2 included: participation in culling ($p = 0.09$), participation in the disinfection of vehicles ($p = 0.007$), apparent health problems ($p = 0.003$), poor health ($p < 0.001$), distress ($p < 0.001$), a lack of someone to talk to ($p = 0.01$), and increased alcohol consumption ($p = 0.02$). The question about having someone to talk to was asked only to the respondents who reported being distressed, and this variable was not entered into the multivariable model. The question on the change in frequency of alcohol consumption was also asked only to those who reported consuming alcohol; the variable entered into the model related only to those who had increase their consumption. The correlation coefficients of these factors were all less than 0.8, and all these factors, with the exception of someone to talk to and an interaction term between health problems and health status ($r = 0.37$), were entered into a multivariable GLM.

The final multivariable model included four factors (Table VIII). The *p*-values of two of the four factors ('participation in culling' and 'alcohol consumption') were slightly above 0.05; however, the model omitted 'participation in culling' and 'increased alcohol consumption'. The two risk factors that remained, namely 'participation in disinfection of vehicles' ($p = 0.02$) and 'distress' ($p < 0.001$), had a larger dispersion parameter (3.3) and residual deviance (183.4 [Akaike Information Criteria cannot be calculated in quasi-statistics]) than the proposed model (2.8 and 119.8, respectively).

Although the *p*-value was greater than 0.05, those who participated in culling had lower K6 values, suggesting healthy worker effect bias. The risk factors were the same as those in the two-variable model, i.e. 'participation in disinfection of vehicles' ($p = 0.01$) and 'distress' ($p < 0.001$).

Discussion

This study has elucidated the dynamics of the mental and physical distress of field veterinarians during the FMD outbreak in Miyazaki, Japan in 2010. A questionnaire was used to obtain numerical data and participatory epidemiology (16) was used to obtain quantitative statements describing the intensity of distress and the changes over time. Control of FMD that involves the culling of animals can cause severe mental distress in the farmers and veterinarians who are involved; however, such distress, especially that of veterinarians, is rarely described in detail. According to the World Animal Health Information Database (WAHID) Interface (22), FMD outbreaks occurred worldwide in 2012 and 2013, especially in China and North and South African countries, so it is clear that there is a risk of introduction of FMD for any country. Therefore, the results presented in this paper offer some insight into the possible mental health care needed for veterinarians and animal technicians participating in animal disease control programmes involving animal depopulation.

During the Miyazaki outbreak, the causes of mental distress changed dynamically as the situation changed. Such change is also commonly observed in non-animal-health-associated disasters (23). Continuous

culling of farm animals over several weeks was a physically intensive task. Moreover, the veterinarians had to work as efficiently as possible in order to halt the progress of the outbreak. However, levels of mental distress (3.1) were significantly higher than levels of physical distress (2.0, $p < 0.001$) among the field veterinarians. This suggested that these veterinarians were highly distressed for a long period of time.

The qualitative analysis provided information not only on mental distress but also on the appropriateness of the control measures taken. The data indicated that at certain points in the control programme there had been problems which may well have reduced its effectiveness. First, the initial response, which is critical in containing an FMD outbreak, was delayed. The time available to implement the most effective and least costly control measures against epidemics while the number of cases remains stationary, i.e. the critical response time (CRT), is short. For example, the CRT of the 2001 FMD epidemic in different regions of Uruguay ranged from 1.4 to 2.7 days (24). This indicates how difficult it is to contain FMD and keep the epidemic small. A mathematical model for the 2010 Miyazaki FMD outbreak found that, even when the disease was detected 14 days earlier, there was still a 35% chance of a large-scale epidemic (more than 500 IPs) (25). Second, the decision to use vaccination was delayed. Again, the mathematical model demonstrated that vaccination within a 10-km radius seven days after the first detection of the disease had the potential to contain the epidemic to a small scale (25). One of the reasons for the delay was a lack of legislation regarding compensation for farmers for FMD emergency vaccination; however, a special act issued by the government quickly settled this issue. Third, confusion in the field over command systems and improper instructions for biosecurity and disinfection might have exacerbated the situation. In the 2001 FMD outbreak in the UK, American veterinarians who voluntarily attended the control programme were distressed by confusion in the field due to a lack of training for culling and proper communication, and a lack of preparation for the consequences of the control policy (26). However, in the control of FMD outbreaks, such confusion may be inevitable.

The final multivariable model should be interpreted with caution. According to additional informal interviews with anonymous AMRA staff members, AMRA employees were allocated to specific disease control tasks on the basis of a decision process which included health checks and interviews; those who were sensitive, nervous and had mental health problems were excluded from participating in culling. As Table VII shows, some of these high-risk employees seemed to have been allocated to the task of disinfecting vehicles; the mean K6 score for these individuals was 5.9, with the highest score being 16 (data not shown). Only those deemed healthy were allocated to culling, and the mean K6 score of those involved in culling was low (2.0, Table VII), suggesting healthy worker effect bias. The respondents with high K6 score exhibited characteristics of being distressed and as a result, alcohol consumption might be increased in these individuals, but the authors considered that increased alcohol consumption in sensitive individuals was a consequence of SMI, not a cause of it. Therefore, no risk factor for SMI due to attendance of FMD control was found.

Although the mean K6 score among those who attended culling was low six months after the final outbreak, there was still a risk that they would suffer from delayed PTSD. In fact, several participants in the focus group discussion mentioned that they have flashbacks, and one of them lost emotional control, indicating hyperarousal, which is one of the symptoms of PTSD (11). Another evaluation instrument, the Impact of the Event Scale – Revised (11), is required for the assessment of PTSD and this was not used in the present survey. Adams and Boscarino (27) classified PTSD following the World Trade Center Disaster into four categories:

– resilient cases (no PTSD years 1 [one year after the attacks]) or 2)
– remitted cases (PTSD year 1 but not year 2)
– delayed cases (no PTSD year 1 but PTSD year 2)
– acute cases (PTSD both years 1 and 2).

Delayed PTSD cases were more likely to have been Latino, to have experienced more negative life events, and to have had a decline in self-esteem.

In the case of FMD in Miyazaki, there could be many negative events associated with participating in the culling of 290,000 heads of livestock. In the 2001 FMD outbreak in the UK, there was distress resulting from the contradiction of vocational pride in caring for animals and the requirement to cull animals instead (26), which was similar to the case in Miyazaki. Moreover, being a veterinarian is a risky vocation for mental distress during such outbreaks, because veterinarians tend to suppress emotion and sacrifice their own mental well-being to help farmers (14). In the UK, it is reported that few veterinary surgeons construed their emotional response to the outbreak as an illness, and they seldom consulted mental health professionals (8). The author has learned (personal communications) that several veterinarians still suffer from mental health issues as a result of FMD control, and some of them have left their job, including those from the other prefectures who attended the culling. Once veterinarians leave their organisation, they become untraceable, so they do not benefit from mental health checks offered by the employer and may remain untreated. As the results of this study suggest, the proportion of veterinarians with SMI in the event of FMD control may not be large. Nonetheless, it is important to screen those who attended the disease control, to provide support to individuals with stress and to take steps to address delayed PTSD cases.

This study was jointly conducted by psychiatry and veterinary experts to fill current knowledge gaps, and is a good example of multisectorial collaboration. In the United States, Nusbaum *et al.* (26) recommended the psychological first-aid training be provided in preparing for outbreaks of acute animal diseases. Moreover, Peck (8) pointed out that mental health specialists could make a greater contribution to the well-being of farmers in the UK by working with and training local veterinary surgeons, because these veterinarians are likely to be asked for support by farmers. Currently, the multisectorial team to which the authors belong is establishing a manual on psychological support in the event of transboundary animal and zoonotic disease outbreaks. However, establishing such a supportive framework between health and agricultural sectors is a daunting challenge at both local and national levels.

In conclusion, human resource allocation based on health checks and interviews seem to have prevented SMI among local field veterinarians in Miyazaki during the FMD control effort. However, it is important to continue monitoring the mental health of the participants of disease control for delayed PTSD, and to establish a One Health framework for mental health to ensure better preparedness.

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Box 1

The causes of psychological difficulties, as reported by veterinarians and supervisors in the focus group discussion

1. Culling
   - There was a stark contradiction between the reason they had become a veterinarian (to save the lives of animals) and the reality of what they were having to do
   - They had to cull the animals of farmers with whom they had been working closely
   - They had to cull young animals
   - The husband of a pregnant wife felt guilty about killing unborn piglets still in the womb and left the team
   - A veterinarian who was the son of a beef cattle farmer experienced shock from the vaccination and culling carried out at his home
   - Biosecurity was not achieved due to confusion regarding commands and the delayed response
   - Disinfectant was ineffective due to mismanagement of the appropriate concentration by non-veterinarians
   - Some veterinarians did not go out during time off to prevent the spread of FMD
   - There was confusion within teams comprising veterinarians from other prefectures and the central government
   - Some veterinarians felt guilty about requesting to leave a team when sick, considering the high levels of distress of the other team members
2. Communication with farmers
   - The activities that caused stress included:
   - Explaining the suspension of veterinary clinical services during the outbreak
   - Being unable to come up with an appropriate response when a farmer reported an outbreak on the phone
   - Making a telephone call about a large number of piglets dying due to FMD
   - Receiving telephone calls from farmers asking how to kill the animals by themselves
   - Dealing with a telephone call about compensation before the decision from AMRA was announced
3. Gender difference
   - Supervisors from AMRAs were not sure that they had done the right thing in deciding not to allocate female veterinarians to culling teams due to a lack of gender-sensitive facilities

for disinfecting and changing clothes

Supervisors regretted not having provided other roles for female veterinarians, such as logistical roles.

FMD: foot and mouth disease

AMRA: Agricultural Mutual Relief Association

Table I

Time spent engaged in foot and mouth disease control activities

Activity	No. of responses	Sex ratio (male to female)	Time engaged per day (%)				Days/month (range)
			< 4 h	4–8 h	8–12 h	> 12 h	
Culling	41	41	2	12	21	6	12
			(4.9)	(29.3)	(51.2)	(14.6)	(1–26)
Vaccination	21	4.3	3	11	7	0	3.2
			(14.3)	(52.4)	(33.3)	(0)	(1–6)
Disinfection of vehicles	8	7	1	4	2	1	4.5
			(12.5)	(50)	(25)	(12.5)	(1–10)
Clinical examination for disease detection	15	10	1	9	2	5	3.6
			(6.7)	(60)	(13.3)	(33.3)	(1–10)

Table II

Average rest time during and after the outbreak

Respondents (n = 62) reported that the busiest months during the outbreak were May and June. The outbreak ended on 4 July 2010

Month	No. of responses	Percentage of responses	Hours of sleep (range)	Days off/month (range)
May	16	25.8	6 (4–8)	8.8 (1–20)
June	32	51.6	6.5 (4–9)	6.3 (0–10)
July	8	12.9	7 (6–8)	6.1 (4–8)
August	6	9.7	6.5 (4–8)	4.2 (1–8)
Overall	62	–	6.5 (4–9)	6.6 (0–20)

Table III
Health problems encountered during foot and mouth disease control

Rank	Health problem	No. of responses (*n* = 65)	Percentage of responses
1	Fatigue	25	38.5
2	Needle-stick , foreign substance in eye(s), dehydration, insomnia	14	21.5
3	Contusion, dermatitis due to disinfectants	13	20
4	Backache	8	12.3
5	Stiff shoulders	7	10.8
6	Headache, anorexia	6	9.2
7	Abrasion, muscle ache/tenosynovitis	4	6.2
8	Stomach ache/abdominal pain	3	4.6
9	Fever, dizziness	2	3.1
10	Difficulty concentrating, hardness of hearing, bone fracture, nausea	1	1.5

Table IV
Health problems reported six months after the final containment of the foot and mouth disease outbreak

Rank	Health problem	No. of responses (*n* = 69)	Percentage of responses
1	Fatigue, stiff shoulders	10	14.5
2	Nasal congestion/runny nose	6	8.7
3	Cough/phlegm, backache	5	7.2
4	Dizziness	4	5.8
5	Insomnia, irritability, visual impairments, tinnitus, palpitations, heartburn, anorexia, rash, numbness of hands or feet, sensitivity to cold, pollakiuria	3	4.3

Table V
Common causes of distress six months after the final containment of the foot and mouth disease outbreak

Rank	Problem	No. of responses (*n* = 70)	Percentage of responses
1	Job	24	34.3
2	Household finances	11	15.7
3	Human relationships (not including family)	10	14.3
4	Education of their children	9	12.9
5	Relationship with family	8	11.4
6	Purpose in life, illness of a family member	7	10.0
7	Illness of respondent, housing and living environment	4	5.7

Table VI
Change in frequency of habits compared with before the foot and mouth disease outbreak
(January 2010 versus January 2011)

Habit	No. of responses	Increased	Not changed	Decreased
Alcohol consumption	51	7 (13.7%)	32 (62.7%)	12 (23.5%)
Caffeine consumption	67	6 (9%)	58 (86.6%)	3 (4.5%)
Gambling	15	1 (6.7%)	9 (60%)	5 (33.3%)

Table VII
Univariate analysis of the risk factors for serious mental illness

Variable	Mean K6 value or slope of $\log_e$K6	*p*-value
Sex	Male 2.6; female 3.1	0.7
Age	Age: slope = 0.002	0.9
	Age group: overall effect	0.8
	– 20s: 2 (13 respondents, $p = 0.1$);	
	– 30s: 3 (18, $p = 0.4$)	
	– 40s: 3.1 (19, $p = 0.4$)	
	– over 50: 2.5 (20, $p = 0.7$)	
Employment	Private clinic 3.1; F-AMRA and AMRA 2.6	0.7
Participation in culling	Attended 2.0; did not attend 3.6	0.09
Participation in vaccination	Attended 2.8; did not attend 2.6	0.9
Participation in disinfection of vehicles	Attended 5.9; did not attend 2.3	0.007
Participation in clinical examinations	Attended 2.9; did not attend 2.2	0.4
Hours of sleep	Slope = –0.04	0.8
Days off/month	Slope = –0.02	0.8
Health problems	Having symptoms 4.6; not having symptoms 1.7	0.003
Health status	Not good 7; other responses 2.2	<0.001
Distress	Distressed 4.3; not distressed 0.7	<0.001
Existence of someone to talk to	Yes 3.3; no 7.3	0.01
Increased alcohol consumption	Increased 6.1; did not increase 2.5	0.02
Increased caffeine consumption	Increased 2.8; did not increase 2.7	0.9
Increased gambling	Increased 0; did not increase 3.4	1.0

Table VIII
Multivariable model of risk factors for serious mental illness

Variable	Estimate	Standard error	*p*-value
Intercept	–0.09	0.43	0.84
Participation in culling	–0.52	0.28	0.07
Participation in disinfection of vehicles	0.82	0.32	0.01
Distressed	1.57	0.44	<0.001
Increased alcohol consumption	0.61	0.31	0.057

Fig. 1
Map showing the locations of Kawaminami-cho and the vaccination zone in Miyazaki Prefecture, Japan

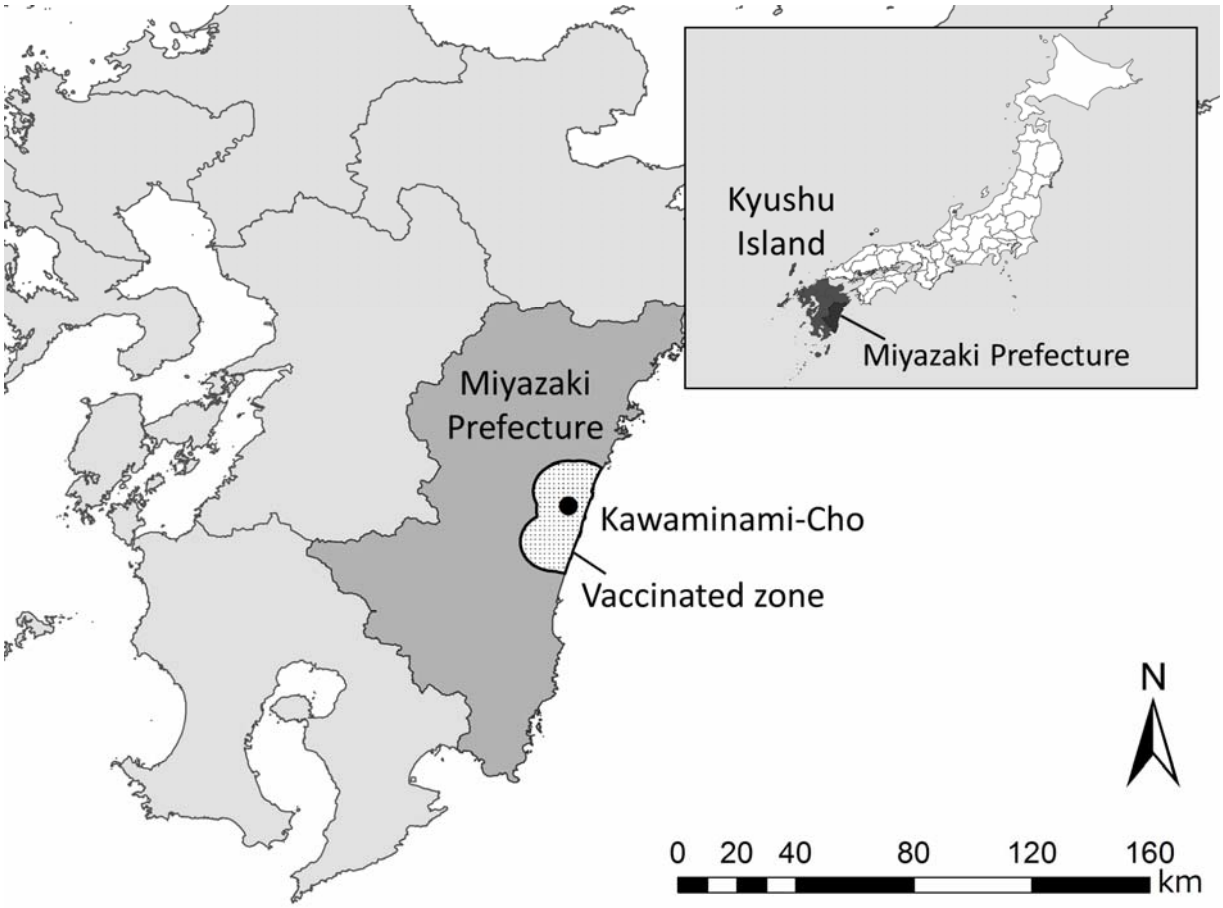

Fig. 2

Temporal change in the causes and intensity of mental and physical distress among field veterinarians during control of the foot and mouth disease outbreak in Miyazaki, Japan in 2010

Y-axis shows the intensity of distress (0: no distress – 4: maximum distress). The solid line shows the mean distress score and the dotted lines show the 95% confidence interval

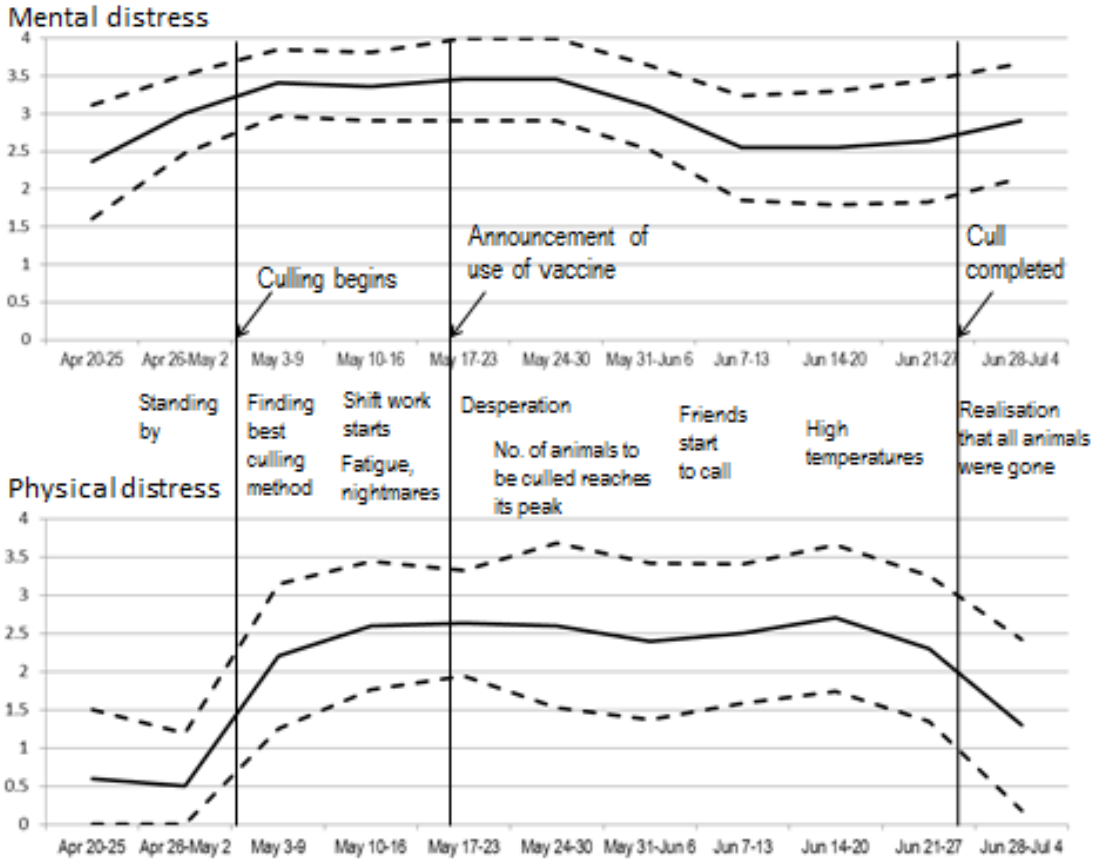

Fig. 3

Temporal change in the causes and intensity of mental and physical distress among supervisor-level veterinarians during control of the foot and mouth disease outbreak in Miyazaki, Japan in 2010

Y-axis shows the intensity of distress (0: no distress – 4: maximum distress). The solid line shows the mean distress score and the dotted lines show the 95% confidence interval