

Title: Impact of Cyclone Fani on Animal Bite Cases in Central Odisha: a Hospital Based Mixed Method Observational Study

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Abstract Introduction: On 3rd May 2019, an extremely severe cyclonic storm-Fani hit the coastal areas of Odisha affecting almost 14 districts. Following which there was a surge in animal bite cases presenting to the tertiary care hospital of central Odisha. Hence this study was planned to compare the trend of animal bites in 2019 to that of four years preceding the cyclone, to study the circumstances that prompted these bites and to suggest preventive measures.

METHODOLOGY: It is a hospital based mixed method observational study. Qualitative research: The in-depth interviews were conducted among participants to know the circumstances of bite and barriers in seeking treatment during cyclone. Thematic analysis was done. Quantitative research: Records of preceding four years, OPD registers of 2013 and 2019 were reviewed purposively and weekly burden of animal bites were compared.

RESULT : Highest numbers of cases per week (448/week) in the last 5 years were seen in the week following cyclone Fani. There was a remarkable increase (38.8%) in weekly case load as compared to the previous 4 years. Key circumstances that lead to bite were power failure, rescue operations, unprovoked bite by pets. Key barriers to proper health care were road blockade, unawareness, unavailability of vaccines in local hospitals.

Conclusion: There was a clear cut increase in the burden of animal bite cases post cyclone Fani. Many cases failed to avail health care due to road blockade, ignorance, lack of treatment facilities in local hospitals. Overall preparedness needs improvement.

INTRODUCTION

During the past 2 decades, natural disasters have killed millions of people worldwide, adversely affecting the lives of at least more than a billion people, and resulting in substantial economic loss [1].

Odisha's vulnerability to natural disaster especially cyclones is noticeable from early days of history.

Geographically, Bay of Bengal is the homeground of cyclones due to its peculiar topography. This acts as an attracting funnel for cyclones in oceanic milieu [2]. Around past half century, Odisha had witnessed many sea cyclones in the years 1971, 1973, 1977, 1981, 1984, 1985, 1987 & 1989. But the super cyclone of 1999, very severe cyclonic storm of 2013 and the extremely severe cyclonic storm of 2019 (Fani) are worth special mention because of the scale of damage caused, ecological disruption, loss of human lives and deterioration of health and health services [3].

Deaths associated with natural disasters, particularly rapid-onset disasters, are overwhelmingly high due to blunt trauma, crush-related injuries, or drowning. The sudden presence of large numbers of dead bodies in the disaster-affected area may heighten concerns of disease outbreaks [4]. Diarrheal disease outbreaks have been reported after flooding in Bangladesh in 2004 [5], Hurricanes Allison [6] and Katrina

[7-9] in USA, Tsunami in India and Indonesia in 2004 [10]. Natural disasters, particularly meteorological events such as cyclones, hurricanes, and flooding, can affect vector-breeding sites and vector borne disease transmission like malaria, dengue etc [11]. A cluster of 106 cases of tetanus, including 20 deaths, occurred in Aceh and peaked weeks after the tsunami [10] particularly in contaminated wounds with low vaccination coverage. Leptospirosis cases have been reported following large floods in Odisha after super cyclone in 1999 [12].

Epidemiological studies in North Carolina have documented a spike in dog bites following hurricane Floyd in 1999 [14]. Following cyclones or hurricanes displacement of domesticated and wild animals are reported in some studies. Dogs, cats and other domestic animals are taken by their owners to or near temporary shelters. While searching for food and safety in the aftermath of a natural disaster, wild animals come closer to affected community increasing chances of transmission of illness such as equine encephalitis, rabies and infections still unknown to humans [12]. Wild animals are also reservoirs of infections which can be fatal to man.

On May 3rd 2019, an extremely severe cyclonic storm named Fani had hit the coastal areas of Odisha affecting almost 14 districts. It was noted that there was a surge in animal bite cases presenting to the tertiary care hospital of central Odisha. However there are very few studies showing the time trend in animal bite cases or rabies incidence following cyclones in different parts of the world and the barriers to health care in such situations. Hence the current study was planned with the following objectives.

- To compare the trend of reported animal bite cases post cyclone Fani, in 2019 with that of Phailin and four years preceding Fani.
- To study the circumstances that prompted these bites and barriers in seeking treatment during and following the cyclone Fani.
- To suggest preventive measures for animal bites and rabies in a similar setting.

1. METHODOLOGY:

1.1. Study setting: A hospital based mixed method observational study was conducted at Anti Rabies Vaccination clinic of a tertiary care teaching hospital in Central Revenue Zone of Odisha in May 2019.

1.2. Sample size and sampling: In total, records of 14,686 patients were studied. In-depth interview of 84 subjects were analysed. Records of the preceding four years, OPD registers of 2013 and 2019 were reviewed purposively. The in-depth interviews were taken purposively till saturation of themes occurred.

1.3. Study subjects: All new animal bite cases attending OPD in the month of April and May were taken as study subjects.

1.4. Inclusion criteria: For the qualitative research, the cases found to be bitten under difficult circumstances following the cyclone or giving history related to the cyclone were included and personally interviewed for their experiences till redundancy. For quantitative analysis all the registered-new animal bite cases in the month of April and May from 2015 to 2019 were included.

1.5. Exclusion criteria: Seriously hurt, actively bleeding patients who required immediate referral were excluded.

1.6. Data collection: OPD registers from 2015 to 2019 for the month of April and May were studied. Similarly, data for 2 months (September and October) were collected for the year 2013 during which Phailin had struck Odisha.

In-depth interview of the patients/ guardians (in case of children below 12 years) was taken using a pre-tested interview guide prepared in the department and translated to local language. The guide was used to probe about causes and difficulties faced in seeking treatment following cyclone. It included questions like, "under what circumstances have you been bitten by the animal?", "Would you elaborate the problems faced while seeking treatment for this animal bite?", "Would you suggest anything to improve the service delivery under such situations like cyclone?"

1.7. Quantitative Analysis: Data were entered in Microsoft Excel 2007 and analyzed in SPSS version 18 (PASW statistics for Windows, Chicago, SPSS Inc.). Appropriate descriptive statistics like mean \pm standard deviation (SD), median with interquartile range (Q1-Q3), were calculated. Data were presented in the form of line diagram and Box-whisker plots. Independent-t test was applied to compare the means of two groups.

1.8. Qualitative analysis: Notes were taken during interview in vernacular language. Thematic analysis was done by each member of the research team independently who reviewed the transcripts to identify the salient themes. The responses obtained during the interviews were translated to English and presented in the boxes in narrative forms.

Ethical consideration: The study protocol was approved by the Institutional Ethics Committee of the teaching hospital. Verbal informed consent was taken from the study participants before the interview and the confidentiality of the data was maintained within the department

1. RESULTS:

1.1. Sample characteristics: Total number of new animal bite cases reported to the OPD in the months of April and May were 3052 in 2019, 2684 in 2018, 2645 in 2017, 2405 in 2016 and 2156 in 2015 respectively (Table 1). The number of new cases in pre and post cyclone month of 2013-Phailin were 817 and 927 respectively.

Out of the total cases, 73.52% (10,798/14,686) were from Cuttack district, rest 26.48% (3,888) were referred cases from other districts. Age wise distribution showed that about 19.8% of animal bites occurred in children upto 15 years of age and 7.4% in age group 65 and above. The male to female ratio being 1.8:1. Dog (67.3%) was the principal biting animal followed by cat (21.2%) and monkey (6.02%). (Data not shown in table)

1.2. Quantitative analyses: It is clear from the Figure-1(A) that there was a steady rise in the reporting of the new animal bites over the period of 5 years starting from 2015 to 2019. It never crossed a total of 400 cases per week in the year 2015-2018. There was a remarkable increase in total number of cases from 399 the week preceding cyclone to 448 in the cyclone week. It was the highest week wise recorded cases in last 5 years. The percentage increase above the baseline (i.e. average number of cases for the first week of May from 2015

to 2018) was found to be 38.8%.

Figure 1(B) clearly shows that there was rise in median number of cases from 55(43-69) in 4th week of April to 69(55-70) and 65(57-69) in 1st and 2nd week of May respectively. The mean value increased from 57+14.5 in week preceding Fani to 64+12.3 in the cyclone week. However the difference was not found to be statistically significant.

Figure-2 shows that there was a definite rise in number of cases in post cyclone period compared to pre cyclone period in both the years. Magnitude of increase following Fani in 2019 was found to be 16% (baseline: week preceding the cyclone) compared to 13.46% during Phailin 2013.

1.3. Qualitative analyses : There were 105 patients fulfilling the inclusion criteria out of which 89 persons consented to be a part of the research, however 5 cases were seriously injured hence excluded from study. So interviews of total 84 study participants were analysed.

Key themes which emerged about Circumstances that lead to bite following cyclone (Box 1) and barriers in seeking immediate treatment following cyclone (Box 2) were as follows.

Box 1: Theme (i). Narrative conversations regarding circumstances leading to animal bite following extremely severe cyclonic storm of 2019, Fani in Odisha.

- **Participant:** "Fani para dina Gote bula kukura bali re poti hei jai thila... bahari paru na thila, ta mu bhabili je ... takukadhibaku chesta kala bele mate kamudi dela."
- o **Translation:** "I was bitten by a stray dog on the day following cyclone while trying to rescue the dog buried with-in the sand and was unable to get up."
- **Participant:** "Line na thila, chari aade andhara ... mora goda padigala kukura ta upare . Mu asithanti je rasta aahuri clear hei na thila khali electric khunta aau gaccha dala ... mu dui dina pare asili"
- **Translation:** "I was bitten by a stray dog as I stepped on it due to power failure in our area following cyclone and came to hospital after 2 days as the roads were blocked by broken trees and electric poles."
- **Participant:** "posa ghara kukura ta .. dui barsa hela ghare acchi ...kebe hele kamudi na thila, fani para dina kanapai kejani kamudi dela"
- o **Translation:** "I was bitten by my pet dog over right foot day after cyclone. It was an unprovoked bite which never took place before."
- **Participant:** "mu rasta clear karuthili ... mu volunteer acchi ta fani pai ...gote kukura gachha daala tale soi thila, hatat kina kamudi dela"
- **Translation:** "I was working as a volunteer in the disaster response team, while clearing the tree branches from road, I was bitten by dog present below one of the tree branches."
- **Participant:** "Mu jane asha karmi. Baatya paradina mu gote garbhabati mahila ku baatya ashraya sthali ru delivery pai hospital ku nei jauthili, sei samaya re biradi te kudipadila, ta nakha baaji gala."
- **Translation:** "I am an ASHA worker. A day after cyclone, while escorting a pregnant lady from temporary shelter for cyclone to hospital for delivery, I received a scratch when a cat pounced on me."

2. Out of total 84 participants, 56 were bitten by animal under difficult circumstances following cyclone. Power failure was cited as the cause of bite by 31 (36.9%) participants. Majority of participants stepped on animals because of extensive power failure. For example one participant described, "I was bitten by a stray dog as I stepped on it due to power failure in our area following cyclone and came to hospital after 2 days as the roads were blocked by broken trees and electric poles." Total 17 (20.23%) volunteers working in rescue team were bitten during relief activity and most of the bites were sudden and provoked. One participant described, "I was working as a volunteer in the disaster response team, while clearing the tree branches from road, I was bitten by dog present below one of the tree branches." Out of other major circumstances, bite while trying to rescue distressed animal was the cause of bite in 6 people (7.14%) and two (2.38%) described sudden unprovoked bites by their pet animal.

3. **Box 2: Theme (ii) Narrative conversations regarding Barriers in seeking treatment following the extremely severe cyclone Fani of 2019 in Odisha.**

- **Participant:** "madam gharu pani bahara karibu na daktar khana asibu? Dhana sabu oda hejaitihila..... aame bhabilu injection tike late hele chaliba."

Translation: Madam should we take care of water logging in house or report to the hospital? There are other priorities like taking care of harvest. we thought injection can be taken later on.

- **Participant:** "kukura kamuda ta ete bada katha boli janinathii... mate agaru biradi kamudi thila kintu mu kichi injection nein na thili"

Translation: I Didn't know that bite is a serious problem and need immediate attention. In the past I was bitten by cat but never sought treatment.

- **Participant:** "mate dui dina tale kukura kamudi thila kintu, rasta gudaka gachha padiki band hei jai thila mu tike kalara patra rasa lagei deichi"

Translation: I was bitten by a dog 2 days back, but the roads were blocked by fallen trees so I came after 2 days and in the mean time I have applied bitter gourd juice over it."

- **Participant:** "aame sange sange pakha CHC ku jaitihilu, kintu semane mana karidela.....tanka pakhe tika nahi boli kahile . Aame kintu ghaa ku sabuna pani re dhoi deichu aau ebe asilu"

Translation: "We rushed to nearest CHC immediately following the bite, but they told that they didn't have stock of ARV vaccines. So we washed the wound with soap water and waited till we could come here."

- **Participant:** "aamara pakha dacter kahile je, line na thiba ru tika guda nasta hejaitihaanta, seth pain aame headquarter ku patheideichu. ta dei heba nahi."

Translation: "The doctors from our nearest hospital told that the vaccines have been transferred to the headquarter hospital in view of power failure. so could not be given."

Among the 45 participants, the predominant barrier in seeking immediate treatment following cyclone cited by 25(29.76%) participants, was unawareness of its seriousness. One participant explained, “: I didn't know that animal bite is a serious problem which needs immediate attention. In the past I was bitten by cat but never sought treatment”. The next most common barrier, cited by 18(21.42%) participants, was road blockade and lack of transportation. One participant who faced this challenge said, “I was bitten by a dog 2 days back, but the roads were blocked by fallen trees so we came after 2 days and in the mean time applied bitter gourd juice over it.” About 10(11.90%) participants described lack of resources in nearest health facility such as vaccines, immunoglobulin and problem in transportation as the cause of delay. For example, one participant stated, “The doctors from our nearest hospital told that the vaccines have been transferred to the headquarter hospital in view of power failure so could not be given.”

Most of the study subjects opined that availability of vaccine stocks near local hospitals could have helped them in availing timely health care, since access to this tertiary care hospital was cut off during this cyclone period. Some of the disaster response staff from NDRF suggested that pre-exposure prophylaxis could have given them the mental assurance for not contracting Rabies while trying to rescue others. One of the ASHA workers went on to suggest that prevention of rabies could be included in their training module in more detail.

4. DISCUSSION

Although Odisha is a cyclone prone state due to its natural geography, but only few studies have been conducted to study the health effects and especially to explore the relation between animal bite and cyclone. Previous work has shown an association of snake bites with naturally occurring disaster [13].

The present study shows an increase in number of animal bites following cyclone Fani. The highest number of cases reported to this tertiary care hospital, in the past 5 years, was seen during post cyclone phase of 2019. When the weekly burden of animal bites was compared with preceding week, a distinctly upward surge was noted. The median increase was found to be 25% and 18% in 1st and 2nd week respectively. Data in similar situation from similar setting are not available to compare.

However, epidemiologists from North Carolina have documented a spike in dog bites following hurricane Floyd in 1999, noting that during 1st week after hurricane, there was a 246% increase. During 2nd week, dog bites still increased by 169%. There was no concurrent report of animal rabies cases. They concluded that increased dog bite probably was a result of displaced, frightened pets [14]. This finding is concordant with our study finding but the level of increase is low which may be due to underreporting of cases to our setup.

In the present study, when the cases were compared with 2013 cyclone (Phailin) the magnitude of rise in 2019 was found to be higher. It can be indirectly linked to the site of impact during Fani which was Central Revenue Zone of Odisha as opposed to Southern Revenue Zone of Odisha during Phailin.

Many animal bite cases were attributed to circumstances arising out of power failure, which made them step on animals unintentionally or which compelled them to sleep outside home on veranda in close proximity with stray animals. Power failure was also cited as a cause of unavailability of vaccines in local health care facilities. Comparable data exploring the relation between animal bite and power failure in such situation was not found in any studies.

After hurricane Katrina in 2005, misplaced dogs and cat bit many rescue workers. Most theories

attributed the increase in bites to fear in the mind of biting animals. Other works have suggested that animal bites are also triggered by meteorological phenomenon [14]. Similar findings were obtained from our study as many NDRF staffs were bitten by stray dogs during their rescue work. Also, general public were bitten by animals while trying to help or feed distressed animals.

In present study, two participants who were bitten by their pets described their unusual restless behaviour. In a study conducted following hurricane Ike in Webster, Texas it was found that almost 80% of the animal bite victims were bitten by their own dogs. Most of them described the bite being unprovoked and un-anticipated from a pet that typically was nonaggressive [15].

In preparation for the storm's impact, the state government of Odisha evacuated over 1.2 million residents from vulnerable coastal areas and moved them to higher ground and into cyclone shelter [16, 17]. For public health reasons; many emergency shelters could not accept pet and other animals. It is known that after an emergency, familiar scents and landmarks get changed. Pet get confused and lost and hence more prone to bite others [18]. In our study one participant reported to be bitten by cat near a shelter while escorting a pregnant lady for delivery. Similarly 6 people were bitten while trying to rescue distressed animal. It is clearly evident from above discussion that such severe cyclones are not only affecting humans but also animals, that's why special attention should be given to rehabilitate both human and animal.

In our study one participant applied juice of bitter gourd leaf over bite site. In a study conducted by Dhiman et al in Himachal Pradesh commonly used home remedies were Kachalu, reetha and burnt hairs of the dogs as it causes more pain and irritation was supposed to be more effective to remove the poison from the site of the wound [19]. Bhargawa et al and Menezes et al found the similar findings [20, 21].

In our study 45 participants cited issues like unawareness of disease seriousness, fear of disruption of routine activities, road blockade, lack of transportation and unavailability of vaccines in local hospitals, as the prominent factors for delay in reporting to health care facilities. Delay in seeking treatment following animal bite was found to be 69.24% (beyond 24 hours) in a study conducted by Dhiman et al. in 2016 [19]. The major reasons for such delay were the distance from health centre, fear of side effects following treatment and unavailability of vaccines in nearby PHC. Above comparison shows that reasons for delay in treatment seeking behaviour under cyclonic condition are comparatively different from normal condition. This clearly indicates the changing demands and much needed preparedness in special situations like cyclone.

Preparedness is the key to preserve human life in the settings of natural disasters. Whenever there is a disruption of routine public health services, there is potential for secondary adverse health effects to develop among the disaster affected population. To avoid being victims of animal bites during and following disasters like cyclones of very high intensity (very severe, super cyclones etc) few steps should be taken at various levels. The general public, health care providers and the rescue workers should be made aware of chances of becoming victims of animal bites during and after disaster especially cyclones. They should try and avoid coming in contact with stray dogs and stepping on pets in darkness. In view of this, they must be given minimum education about first aids like washing of wounds with soap and running water for 15 to 20 minutes.

They should also be sensitized about other dos and don'ts after animal bite. The authorities might consider pre-exposure prophylaxis against rabies for rescue workers as it can be a cost effective strategy

compared to post exposure prophylaxis in a country like India where rabies is endemic and mortality from this disease is also very high. As IMD is giving information regarding time, severity and areas to be affected by cyclones well before, the contingency plans prepared by the MOs at peripheral health facilities should be such that such emergency services would not get affected much. As it is a hospital based study, it only reflects the view point of person reporting to the OPD but real magnitude of this problem cannot be estimated from the above study design.

5. CONCLUSION:

Burden of animal bites at tertiary care hospitals following natural disasters like extremely severe cyclonic storm is found to be significantly increased. The circumstances of such instances are mostly confrontation with displaced and distressed animals including pets. The preparedness on part of the peripheral health facilities for post exposure prophylaxis of animal bites is found to be insufficient. The awareness of the public, health care workers, including the field staffs of rescue teams regarding first aids and primary prevention needs improvement.

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Table 1: Total number of new cases in the month of Apr- May from 2015-2019 and 2013 (N= 14,686)

Year/Month	April	May	Total
2019 (Fani)	1443	1609	3052
2018	1402	1282	2684
2017	1286	1359	2645
2016	1232	1173	2405
2015	1099	1057	2156
2013 (Phailin)	817 (Sept)	927 (Oct)	1,744

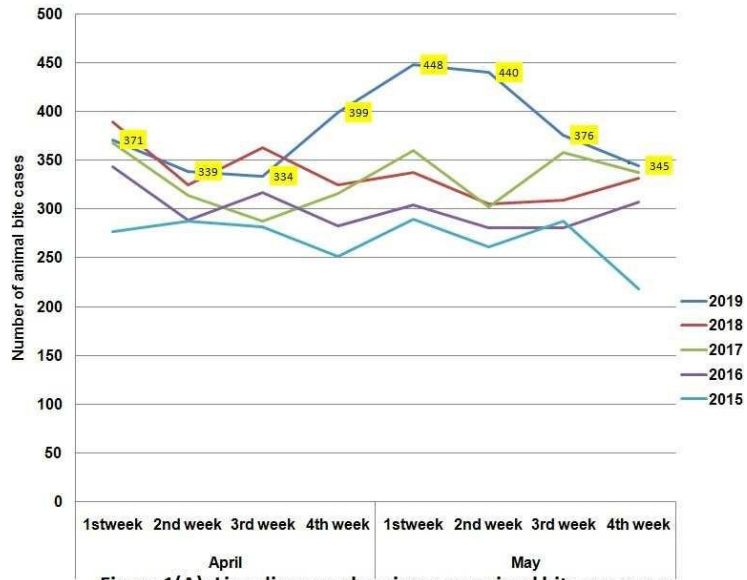


Figure 1(A): Line diagram showing new animal bite cases per week in April- May from 2015-2019

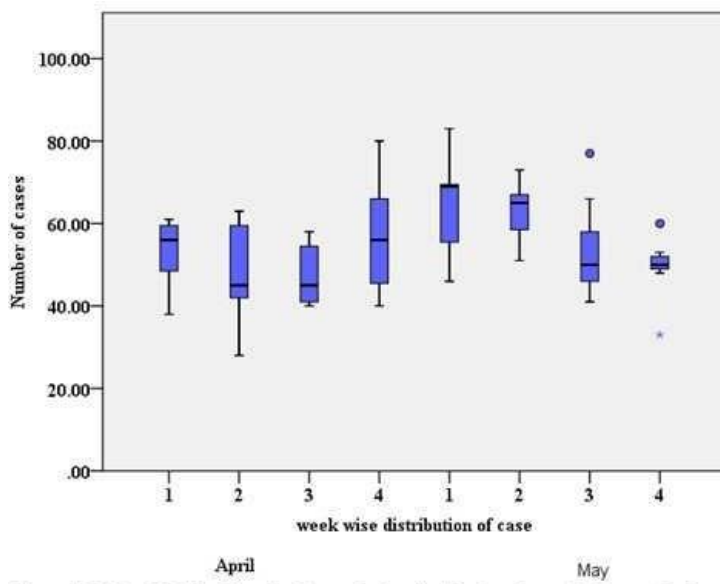


Figure 1(B): Box Whisker Plot showing weekwise distribution of cases in the month of April- May 2019

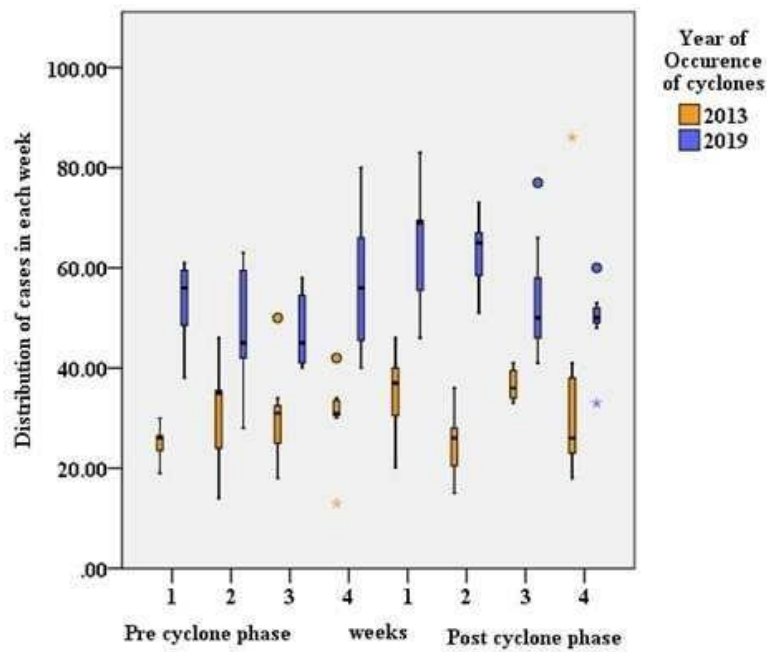


Figure-2: Box-whisker plot showing comparison of distribution of cases around median value in 2013 and 2019.

