A study to measure the impact of festivals and elections on Covid19 cases in Gujarat

By

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In **Hindustan Times (2021)**, article " 'Main Reason for Spike in COVID19 Cases' Helath Minister Harsh Vardhan as India's sees highest daily spike of 2021" brought to light that COVID19 cases are increasing very rapidly in India. Presently the total number of cases is more than two lakhs. Worldwide India is the third most affected country from COVID19 pandemic in 2021 after USA and Brazil. In India, states like Maharashtra, Punjab, Karnataka, Gujarat and Tamil Nadu only contribute more than 78% new cases from overall cases. The main reason for this as informed by Dr. Harsh Vardhan (Union Health Minister) was that people are not following social distancing and corona guidelines seriously as much as it is needed (1).

The Indian Express (2021), in the article titled "Explained: Why Gujarat witnessing a surge in COVID19 cases?" explained some major reasons for increase in number of COVID19 cases in Gujarat. Few reasons included interstate transport, international cricket match, rise in number of public programs, local elections for municipal corporations, municipalities, district panchayats and taluka panchayats in Feb, 2021. The State Health Department and Gujarat High Court warned to control large political rallies and large crowd gatherings during election campaigns in the state. The High Court of Gujarat informed that before Diwali festival due to human interactions in Diwali shopping raised the number of cases upto 1600 per day in Gujarat. The Chief Justice of Gujarat High Court expressed his deep concern and felt shocked due to no control on festive celebrations for COVID19 guidelines (2).

The **Hindustan Times (2020)**, article "Festival Season, small gatherings aid spread of COVID19 warn experts" explained that festive celebrations and small family gatherings at home and shopping trips can lead to rise in COVID19 cases. It stated examples of different Indian states like New Delhi, Maharashtra and Kerala who have previously recorded hike in COVID19 cases after festivals like Navratri, Ganesh Chaturthi, Onam, Rakhabandhan, Eid and Durga Puja. Dr. Rommel Tickoo (Associate Director of Internal Medicine at Max Hospital, Saket) says that people do not wear mask, maintain social distance or proper sanitization during and after large gatherings, which can lead to increase in number of cases. Dr. Suranjit Chatterjee (Consultant of Internal Medicine at Indraprastha Apollo Hospital) remarked that when families meet during festivals it increase the spread of COVID19 from younger to elder ones. Even speaking or singing loudly at events like Jagratas can spread corona says Dr. Lalit Kumar (Indian Council of Medical Research) (3).

Objective:

1. To measure the impact of festivals and election on COVID19 cases in Gujarat.
2. To study the impact of number of COVID19 cases on death due to COVID19 on positively affected festivals and elections in Gujarat.

Hypothesis:

1. There is no significant relation between number of COVID19 cases before and after festivals and public holidays in Gujarat.
2. There is no significant relation between number of COVID19 cases and number of deaths due to COVID19 on positively affected festivals and elections in Gujarat.

Research Methodology:

The present study aims to study the impact of festivals and elections on the COVID19 cases in Gujarat. The study covers the total period affected of COVID19 in Gujarat from 20 March, 2020 upto 11 April, 2021. It is based on secondary data collected from published articles, reports and internet of WHO, Ministry of Health-Government of India and Government of Gujarat. The different variable festivals were studied using Mean, Median, Karl Pearsons Product Correlation, Regression and Paired T test using SPSS software.

Data Collection and Analysis:

The study is based on secondary data collected from national and international reports from WHO, Govt. of India and Govt. of Gujarat on COVID19, publications in newspapers and journals and mostly internet. The total population is studied for festivals and holidays as per the official gazette list for the period between March 2020 upto April 2021.

Frequency Tables:

	Frequency	Percent
FESTIVAL	28	90.3
ELECTIONS	3	9.7
Total	31	100.0

Table1: Details of Number of Festivals and Elections for the period between 24 March, 2020 upto 11 April, 2021.

MONTH * TYPE Crosstabulation

		TYPE		Total
		FESTIVAL	ELECTIONS	
MONTH	March-20	1	0	1
	April-20	5	0	5
	May-20	2	0	2
	June-20	1	0	1
	August-20	6	0	6
	October-20	5	0	5
	November-20	2	1	3
	December-20	1	0	1
	January-21	2	0	2
	February-21	0	2	2
	March-21	2	0	2
	April-21	1	0	1
Total		**28**	**3**	**31**

Table2: Month wise Details of Number of Festivals and elections for the period between March 2020 upto April 2021

In the month of August 2020 there are maximum number of festivals i.e. 6 festivals followed by April 2020 and October 2020 i.e. 5 festivals. Overall three elections were held in Gujarat for the period between March 2020 upto April 2021 from which two local elections for were held in February 2021 and one By-election for 8 seats in November 2020.
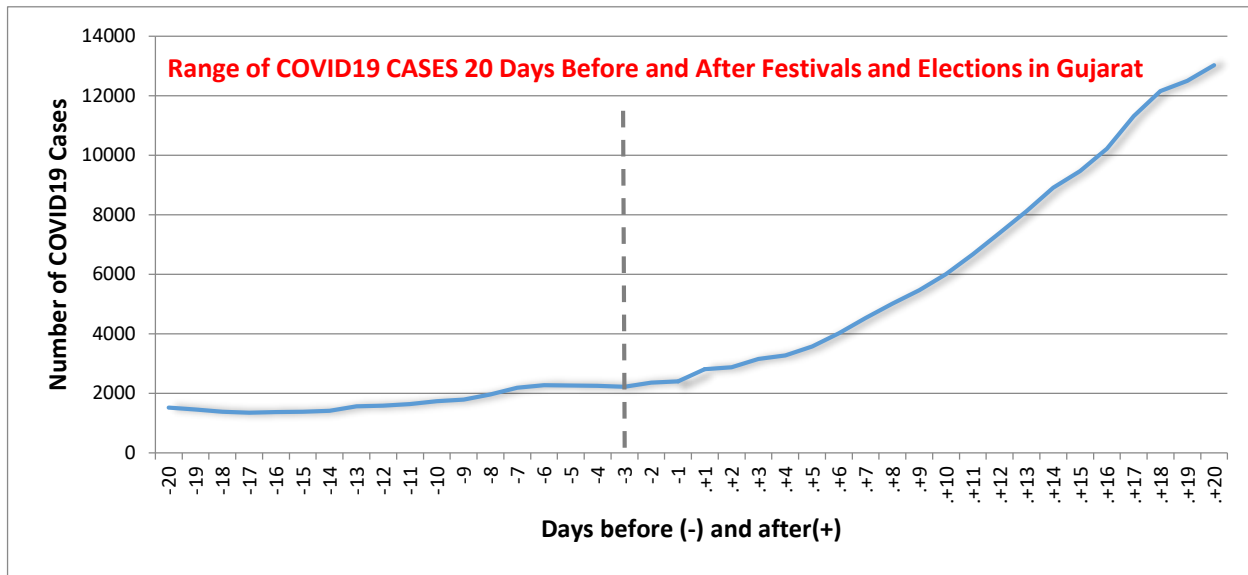
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Fig1. Range for number of COVID19 cases before and after 20 days of festivals and elections in Gujarat:

The range data for all the festivals and elections showed that before the events there is a steady increase in COVID19 cases at 59%. The number of reported COVID19 cases increased more than 350% after festivals and elections. So there is increase in COVID19 cases of more than 300% (305=364[after] – 59[before]) after festivals and elections in Gujarat from 24 March, 2020 upto 11 April, 2021. The data showed that after festivals and elections the number of COVID19 cases increased more than 100% (in first 10 days) and 95% (after 10 days upto 20 days).
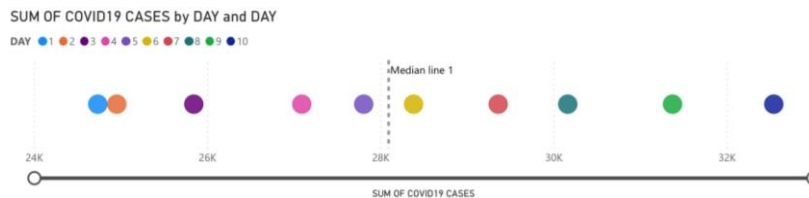
Central Tendency:

Figure 2: Median for first Ten Days for Number of COVID19 Cases

Mean and Median of COVID19_CASES

Mean	28226.70
Median	28096.00

Table 3: Mean and Median of COVID19 cases after festivals and elections for first ten days.

From first days upto 10th day after festivals and elections using Mean and Median the central point for the data showed that data is centered at 6th day after festivals and elections showed the highest number of reported COVID19 cases.

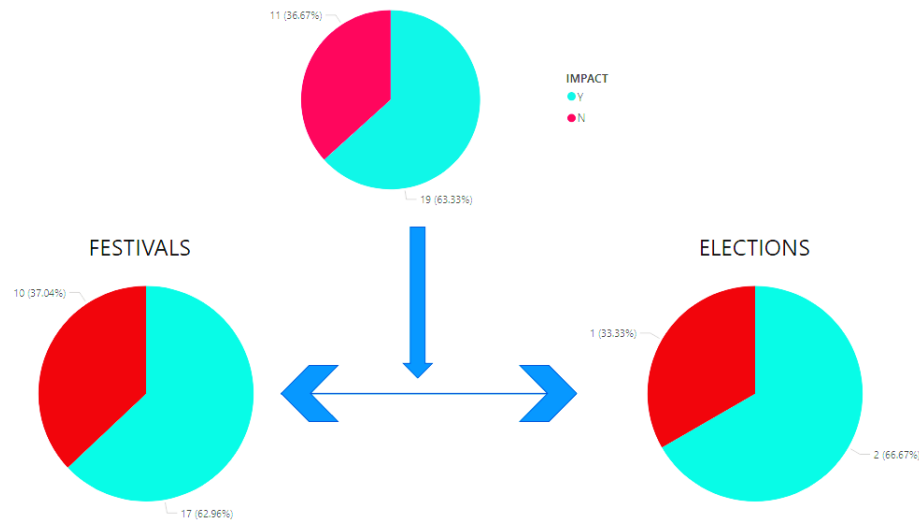Measure impact of festivals and elections on COVID19 cases:

Figure 4: (+Yes/-No) Impact of Festivals and Elections on COVID19 cases on sixth day before and after difference.

The difference for number of COVID19 cases in Gujarat before and after 6 days of festivals and elections showed positive impact on 63% events including 17 festivals and 2 elections. From further analysis it can be concluded that not all the events are affected by festivals and elections. But out of total events there are almost two third events which showed that increase in COVID19 cases due to festivals and elections.
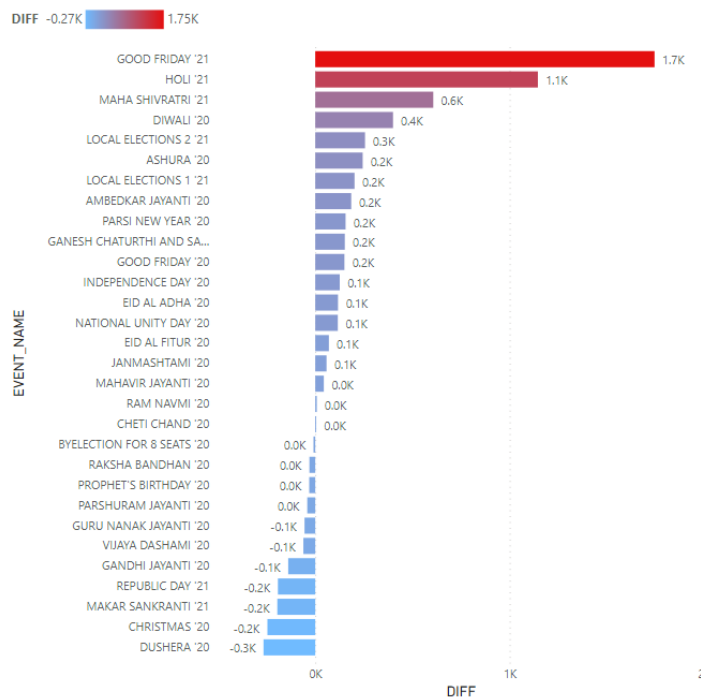

Figure 5: Event wise details of Difference between six days before and six days after of Number of COVID19 cases.

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Among them Good Friday, Holi and Mahashivratri celebrations in 2021 noted the maximum number of COVID19 cases. Whereas Dushehra, Christmas in 2020 and Makarsankranti in 2021 reported most negative impact on COVID19 cases. Furthermore Byelections in November 2020 showed negative variance whereas two Local Elections in February 2021 showed positive variance for before and after 6 days of number of COVID19 cases.

AFTER 6 DAYS and BEFORE 6 DAYS by DATE
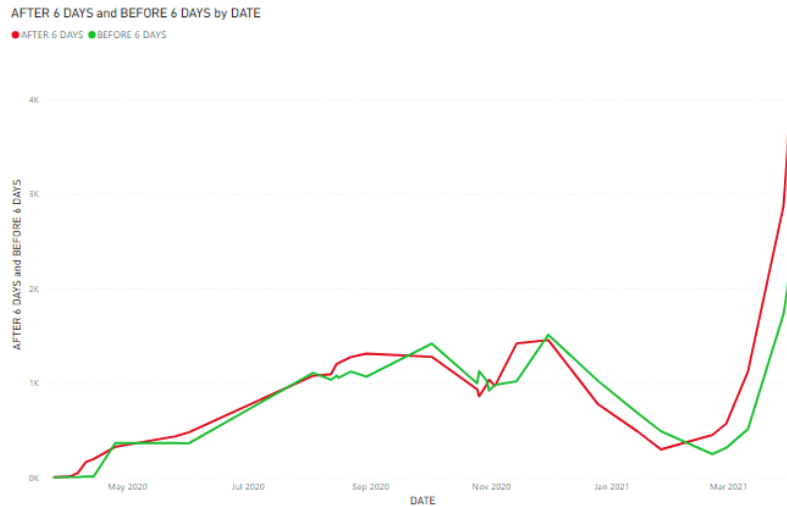● AFTER 6 DAYS ● BEFORE 6 DAYS

Figure 6: Month wise details of COVID19 cases six days before and six days after from March 2020 up to April 2021.

The month wise data for number of COVID19 cases six days before and six days after festivals from March 2020 up to March 2021 showed that from March 2020 up to September 2020 the number of COVID19 cases has increased gradually. After September 2020 up to November 2020 number of COVID19 cases has reduced up to some extent and then increased suddenly up to end of December 2020. From December 2020 up to January 2021 the COVID19 cases reduced most significantly and then it shoots up like a rocket after February 2021.

Hypothesis1: There is no significant relation between number of COVID19 cases before and after festivals and public holidays in Gujarat.

Test of Normality:

The data for number of COVID19 cases before six days and after six days on positively impacted festivals and elections when tested for normality using Kolmogorov Smirnov, Histogram and Q-Q plots showed that data for "After 6 Days" was not normally distributed for which the square root was taken and again normality was tested which showed that the data was normally distributed at 0.05 level of significance using Kolmogorov Smirnov and Histogram.

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
SQRT_BEFORE	.186	19	.082
SQRT_AFTER	.156	19	.200[*]

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Table 4: Normality test for no. of COVID19 cases before and after six days of events.
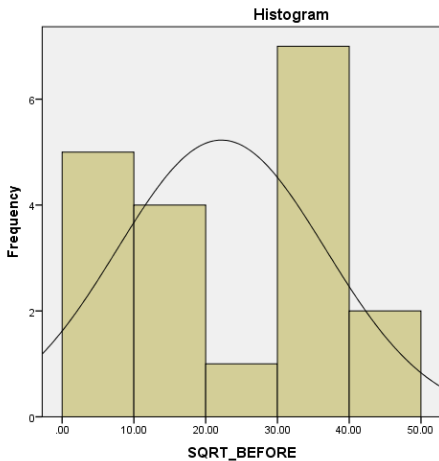

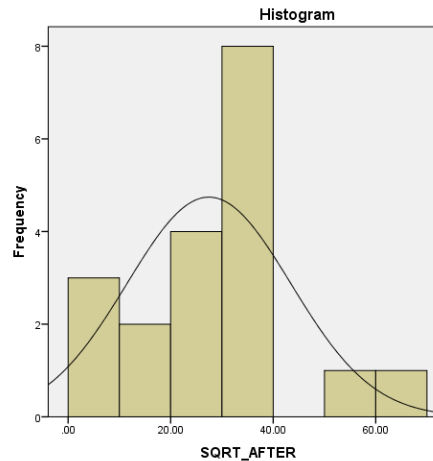Figure 7: Histogram for Normality of COVID19 cases before six days

Figure 8: Histogram for Normality of COVID19 cases after six days

Paired Sample T-Test:

Table 5: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SQRT_AFTER	27.4586	19	15.98168	3.66645
	SQRT_BEFORE	22.1898	19	14.50033	3.32660

Table 6: Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
SQRT_AFTER - SQRT_BEFORE	5.26886	4.39692	1.00872	3.14961	7.38811	5.223	18	.000

To analyses the impact of festivals and elections on number of COVID19 cases before six days and after six days Paired Sample T Test was used. The result showed that the data is not significant at 0.05 level of significance (0.000) hence reject null hypothesis and accept alternate hypothesis. The test explained that there is significant impact of about 5 cases (mean difference = After "27.4586" – Before "22.1898") due to positively impacted festivals and elections.

Hypothesis 2: There is no significant relation between number of COVID19 cases and number of deaths due to COVID19 on positively affected festivals and elections in Gujarat.

Date	FESTIVAL NAMES	TOTAL CASES 6 DAYS	TOTAL DEATHS 6 DAYS

3/25/2020	CHETI CHAND	36	4
2/4/2020	RAM NAVMI	98	9
6/4/2020	MAHAVIR JAYANTI	370	12
10/4/2020	GOOD FRIDAY	551	17
4/14/2020	AMBEDKAR JAYANTI	1289	43
5/25/2020	EID AL FITUR	2319	149
1/6/2020	EID AL ADHA	2870	186
12/8/2020	JANMASHTAMI	6484	107
8/15/2020	INDEPENDENCE DAY	6752	102
8/16/2020	PARSI NEW YEAR	6843	96
8/22/2020	GANESH CHATURTHI AND SAMVATSARI	6929	95
8/30/2020	ASHURA	7835	85
10/31/2020	NATIONAL UNITY DAY	5689	32
11/14/2020	DIWALI	7162	40
2/21/2021	LOCAL ELECTIONS 1	2378	4
2/28/2021	LOCAL ELECTIONS 2	2922	4
3/11/2021	MAHA SHIVRATRI	5266	12
3/29/2021	HOLI	15320	66
2/4/2021	GOOD FRIDAY	19726	116

Table 7: List of dates, events, COVID19 cases and deaths of positively affected festivals and elections based upon sixth day

Test of Normality:

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
SQRT_CASES	.179	19	.110
SQRT_DEATHS	.170	19	.149

Table 8: Test of normality for No. of COVID19 cases and No. of COVID19 deaths for positively affected events
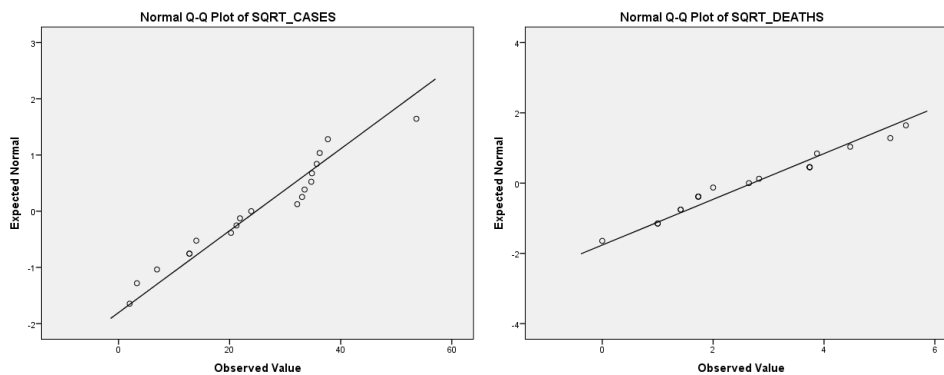

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Figure 9: Q-Q plots of Number of COVID19 cases for positively affected events

Figure 10: Q-Q plots of Number of COVID19 deaths for positively affected events

The data for Square root of Number of COVID19 on 6th day after festival or election and Square root of number of death due to COVID19 on 6th day after festival and election showed normal distribution at 0.05 level of significance by Kolmogorov Smirnova and Q-Q plots.

Correlation:

		SQRT_CASES	SQRT_DEATHS
SQRT_CASES	Pearson Correlation	1	.521*
	Sig. (2-tailed)		.022
	N	19	19
SQRT_DEATHS	Pearson Correlation	.521*	1
	Sig. (2-tailed)	.022	
	N	19	19

Table 9 : Correlation between COVID19 Cases and COVID19 deaths

The correlation between Squareroot of Number of COVID19 Cases and Squareroot of Deaths due to COVID19 showed that there is significant relation at 0.05 (0.521) level of significance. Hence null hypothesis is rejected and alternate hypothesis is accepted.

Simple Linear Regression and Model of fit:

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.521[a]	.272	.229	1.34903	.272	6.350	1	17	.022

ANOVA[a]

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	1.264	.652		1.940	.069
SQRT_CASES	.058	.023	.521	2.520	.022

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	11.557	1	11.557	6.350	.022[b]
Residual	30.938	17	1.820		
Total	42.495	18			

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Table 10: Simple Linear Regression Model Statistics, ANOVA and Model Values.

Regression analysis showed the extent of impact of number of COVID19 cases on death due to COVID19 on 6th day after festivals and elections in Gujarat. The independent variable number of COVID19 cases and the dependent variable is number of deaths due to COVID19. Thus the arrived model includes constant value of 1.264 and slope of regression line 0.058.

$$Y = a + bx$$

where, Y = estimated value of no. of COVID19 deaths for i[th] no. of COVID19 cases

a = y intercept / constant

b = slope

x = number of COVID19 cases for i[th] observations

Regression Equation/Model of fit: Y = 1.264 + 0.058 x

Goodness of fit/ Coefficient of Determination:

Coefficient of determination or R squared shows the reliability of the predicted regression model.

R squared/Coefficient of determination = $\dfrac{\text{Sum of squares of Regression}}{\text{Total Sum of squares}}$

R squared   = 11.557 / 42.495

= 0.271961

The R squared for regression model of COVID19 cases on COVID19 deaths showed that the predicted **model is 27% reliable** which can be considered as very low level of reliability. Thus it concludes that the present model is not very much reliable and incase and to increase its reliability more data needs to be analyzed.

Conclusion:

- The range data for 31 events for twenty days before and after the event date showed that there was great increase in number of COVID19 cases after the event date. From which more than 100% increase is seen in the first ten days after the event.
- The data is cantered at 6th day from overall first 10 days after the day of events.
- Comparison between six days before and six days after the event date showed that equals to or more than equals to two third from all the events showed positive impact of festivals and elections on increase in COVID19 cases.
- The positively affected festivals and elections showed that after festivals and elections the number of COVID19 cases is on an average 5 times more than before.
- There is a significant relation between COVID19 cases and COVID19 deaths on 6th day after festivals and elections positively affected based on comparative analysis.
- The regression model Y = 1.264 + 0.058 x for Number of COVID19 deaths over number of COVID19 cases, showed reliability at 27%.

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(1) Sabarwal, H. (2021, March 15). 'Main reason for spike in Covid-19 cases...': Health minister Harsh Vardhan as India's sees highest daily spike of 2021. Retrieved April 11, 2021, from https://www.hindustantimes.com/india-news/health-minister-gives-main-reason-for-recent-spike-in-india-s-covid-19-tally-101615803706636.html

(2) Ghosh, S. (2021, March 24). Explained: Why is Gujarat witnessing a surge in Covid-19 cases? Retrieved April 13, 2021, from https://indianexpress.com/article/explained/explained-why-gujarat-is-witnessing-a-surge-in-coronavirus-cases-7236995/

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small-gatherings-aid-spread-of-covid-19-warn-experts/story-3UzT32Mw6MwhbPgLnFxTMJ.html