Covid-19 Data Analysis For Second Wave Indian Pandemic Seir Model By Using Principal Component Analysis Tool

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ABSTRACT: This paper we discussed pre and post data for COVID-19 with 9 parameters SEIR model (second wave Indian pandemic) by using PCA (PRINCIPAL COMPONENT ANALYSIS) approach. Also we verify the validity of the system from government control polices. The prediction obtained from real life data for COVID-19 and finding 9 parameters % for government control policy.

Keywords: COVID-19 data, second wave Indian pandemic SEIR, PCA, Parameter validation, finding % for government control policy.

1. INTRODUCTION

We know that history of COVID-19 very well. Now lots of author's published papers in COVID-19 only [1]-[15]. In this regard, we have taken 9 parameters from government policies and the validity or percentage of verification from the real life data. This model is second wave for Indian Pandemic of SEIR (susceptible-exposed-invectives-recovery) model. We calculated the percentage of parameters such as Social distancing, Wear mask, hand gloves, thermal screening, frequent hand washing with soap, sneezing with a tissue, sanitizer dispenser, frequent sanitization and Quarantine for 14 days [16]-[30].

Here we used the parameters estimation with the help of PCA (PRINCIPAL COMPONENT ANALYSIS), it is one of the Eigen values method. The PC1 & PC2 approaches give the estimation of control parameter values based on the Eigen values properties [31]-[42]. The pre and post COVID-19 data are taken from WHO (World Health Organisation) or government recognised bodies [30]. The pre and post PCA gives the percentage of government control policy percentages. It helps for checking the government policies.

2. MATHEMATICAL DOLEING OF COVID-19 DATA ANALYSIS FOR SECOND WAVE INDIAN PANDEMIC

Let us consider the Indian second wave SEIR model as below and the parameter description is given by Table 1.

$$\frac{\mathrm{d(Susceptilpe)}}{\mathrm{dt}} = \alpha_1 - \alpha_2 SE - \alpha_3 S$$

$$\frac{\mathrm{d(Exposed)}}{\mathrm{dt}} = \alpha_2 SE - (\alpha_3 + \alpha_4 + \alpha_5)E$$

$$\frac{\mathrm{d(Infectives)}}{\mathrm{dt}} = \alpha_4 E - (\alpha_3 + \alpha_4 + \alpha_6)E$$

$$\frac{\mathrm{d(Hospitalised)}}{\mathrm{dt}} = \alpha_7 I - (\alpha_3 + \alpha_8 + \alpha_9)H$$

$$\frac{\mathrm{d(Recovery)}}{\mathrm{dt}} = \alpha_8 H + \alpha_5 E - \alpha_3 R$$

(1)

Table 1 Parameter description		
S.No	**Parameters**	**Description**
1	α_1	Social distancing
2	α_2	Wear mask
3	α_3	hand gloves
4	α_4	thermal screening
5	α_5	frequent hand washing with soap
6	α_6	sneezing with a tissue
7	α_7	sanitizer dispenser
8	α_8	frequent sanitization
9	α_9	Quarantine for 14 days

3. PCA SOLUTIONS OF SECOND WAVE INDIAN PANDEMIC

The Table 2 & 3 shows the Parameter estimation of COVID-19 pre data and Parameter estimation of COVID-19 post data [31]-[42]. We calculated the average (mean) and variance values from the COVID-19 data. Then we obtained PC1 &PC2 Eigen values. At present we have taken 21 samples and verify the 9 control policies for strategy. Here the lockdown parameter is not given and lots of papers discussed so far. After that, we discussed Pre- Principal Component Analysis & Post- Principal Component Analysis with the help of MATLAB figure. This method is very easy to check the control strategy.

Table 2 Parameter estimation of COVID-19 pre data					
	Eigenvalues estimation			Sums of the squares of the Eigenvalues estimation	
Component	Mean	Variance	Mean average	Variance average	PC1 & PC2 values
1	1	0.2	0.004184	0.014684	1.000
2	2	0.3	0.008368	0.022026	1.100
3	4	0.6	0.016736	0.044053	
4	5	0.7	0.020921	0.051395	
5	7	0.11	0.029289	0.008076	
6	8	0.67	0.033473	0.049192	
7	11	0.8	0.046025	0.058737	
8	23	0.9	0.096234	0.066079	
9	25	0.95	0.104603	0.06975	
10	27	0.99	0.112971	0.072687	
11	11	0.5	0.046025	0.036711	
12	12	0.6	0.050209	0.044053	
13	15	0.7	0.062762	0.051395	
14	6	0.8	0.025105	0.058737	
15	7	0.6	0.029289	0.044053	
16	8	0.5	0.033473	0.036711	
17	9	0.7	0.037657	0.051395	
18	12	0.8	0.050209	0.058737	
19	13	0.9	0.054393	0.066079	
20	16	0.6	0.066946	0.044053	
21	17	0.7	0.07113	0.051395	

Table 3 Parameter estimation of COVID-19 post data

Component	Eigenvalues estimation			Sums of the squares of the Eigenvalues estimation	
	Mean	Variance	Mean average	Variance average	PC1 & PC2 values
1	2	0.1	0.008368	0.007342	1.570
2	3	0.2	0.012552	0.014684	2.000
3	5	0.4	0.020921	0.029369	
4	7	0.5	0.029289	0.036711	
5	9	0.1	0.037657	0.007342	
6	8	0.57	0.033473	0.04185	
7	10	0.8	0.041841	0.058737	
8	18	0.9	0.075314	0.066079	
9	21	0.92	0.087866	0.067548	
10	26	0.95	0.108787	0.06975	
11	10	0.6	0.041841	0.044053	
12	11	0.5	0.046025	0.036711	
13	14	0.6	0.058577	0.044053	
14	7	0.8	0.029289	0.058737	
15	8	0.5	0.033473	0.036711	
16	9	0.5	0.037657	0.036711	
17	10	0.6	0.041841	0.044053	
18	11	0.7	0.046025	0.051395	
19	12	0.9	0.050209	0.066079	
20	15	0.5	0.062762	0.036711	
21	16	0.6	0.066946	0.044053	

4. RESULTS AND DISCUSSION

In this section Figure 1 to 8 shows the 9 parameters of our model with the help of MATLAB by equation (1). Finally we concluded the percentage of each parameter from PCA approach. This approach is useful for Indian government to check the control strategy of COVID-19 spread. It gives a good result for public, and uses of the decision taken. For example, wearing mask is the highest percentage of our calculation. So we decided that is a best government policy. This is one of the decision makers for Indian people. We used pre and post both PCA techniques for these 9 parameters.

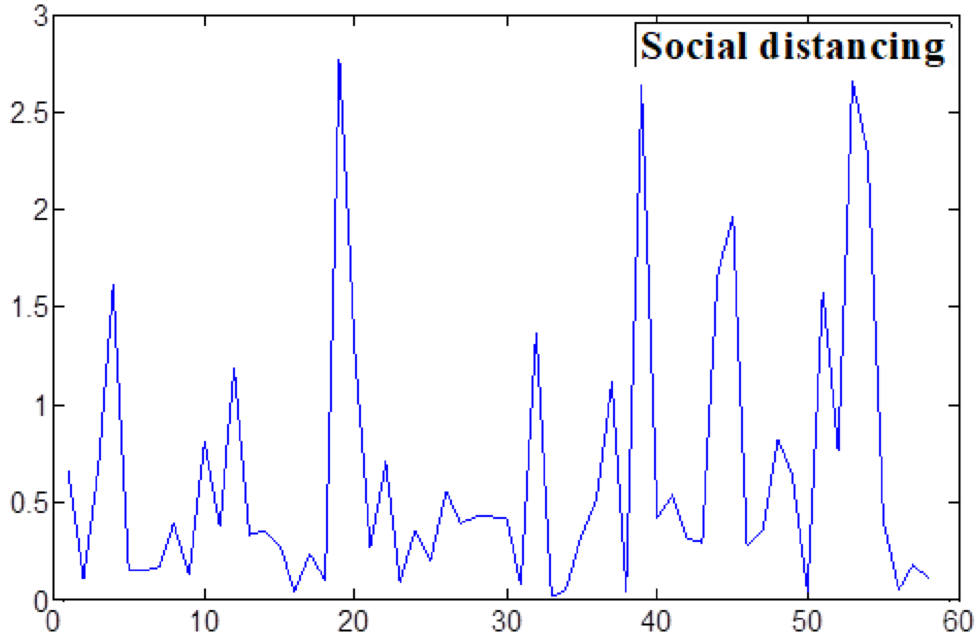

Figure 1 Pre-PCA analysis for social distancing

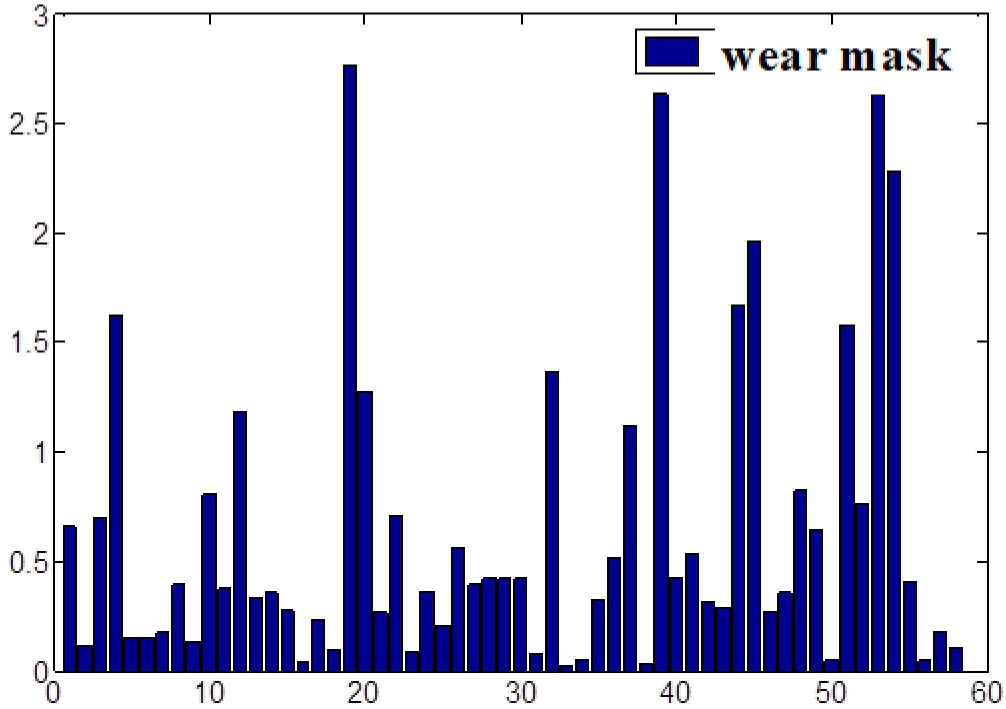

Figure 2 Pre-PCA analyses for wear mask bar diagram

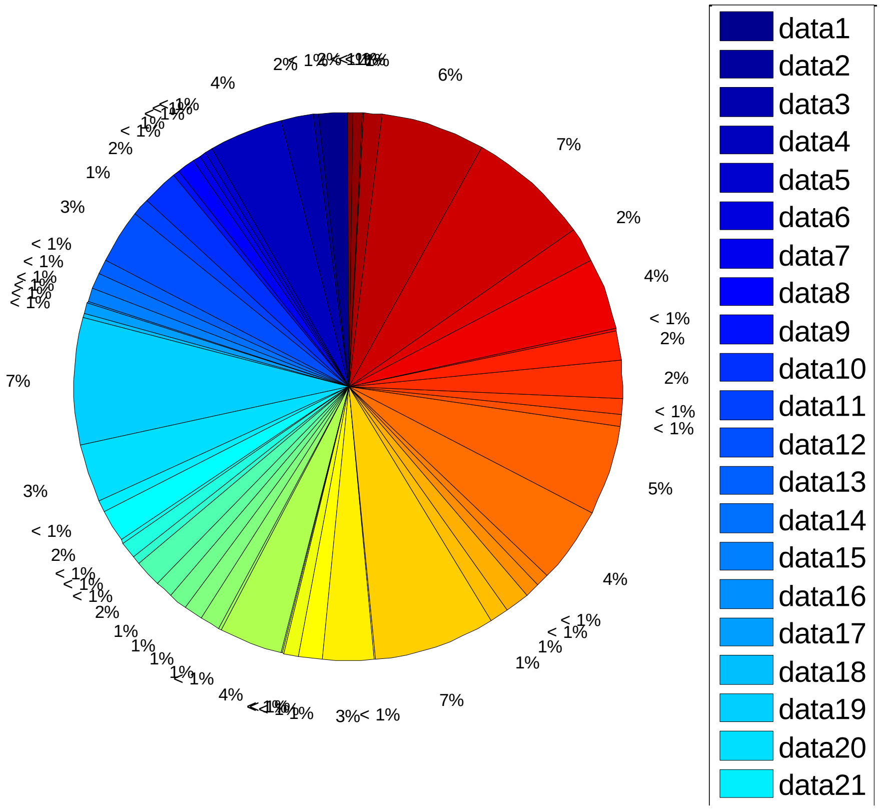

Figure 3 Pre-PCA analyses for 21 data of hand gloves

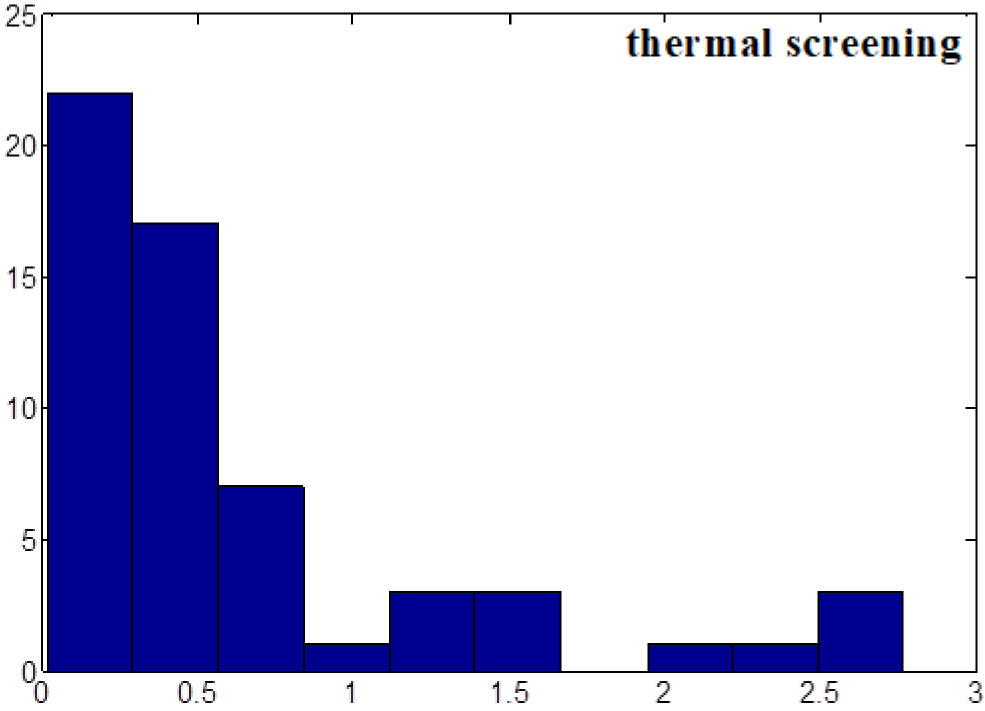

Figure 4 Pre-PCA analyses for thermal screening ratio bar diagram

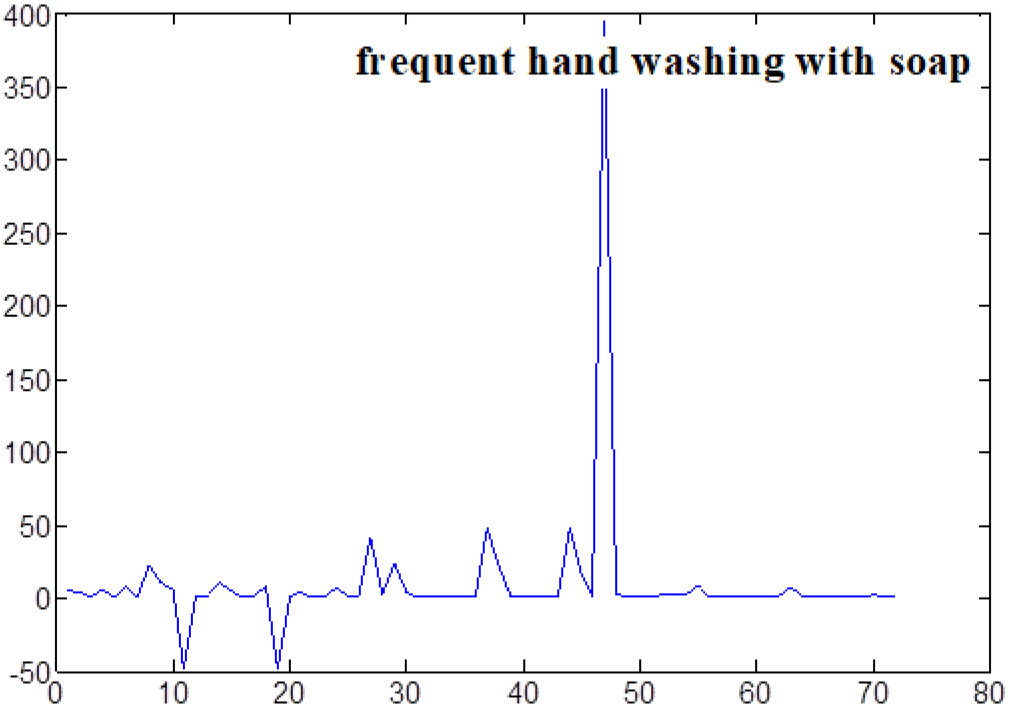

Figure 5 Post-PCA analyses for frequent hand washing with soap

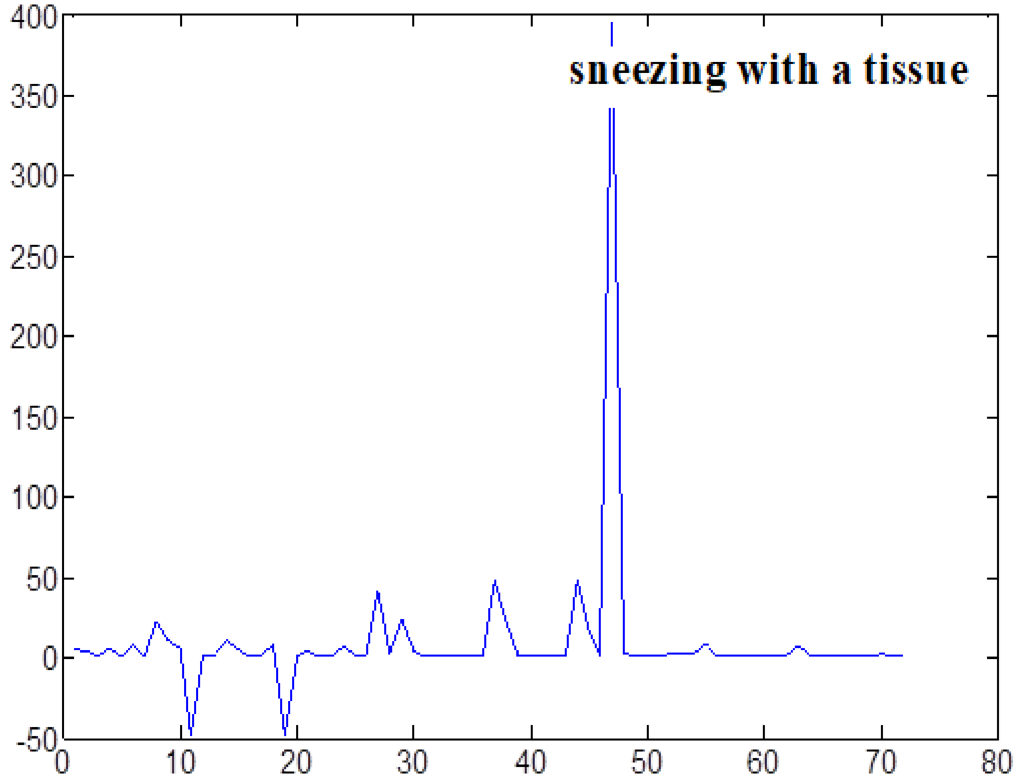

Figure 6 Post-PCA analyses for sneezing with a tissue

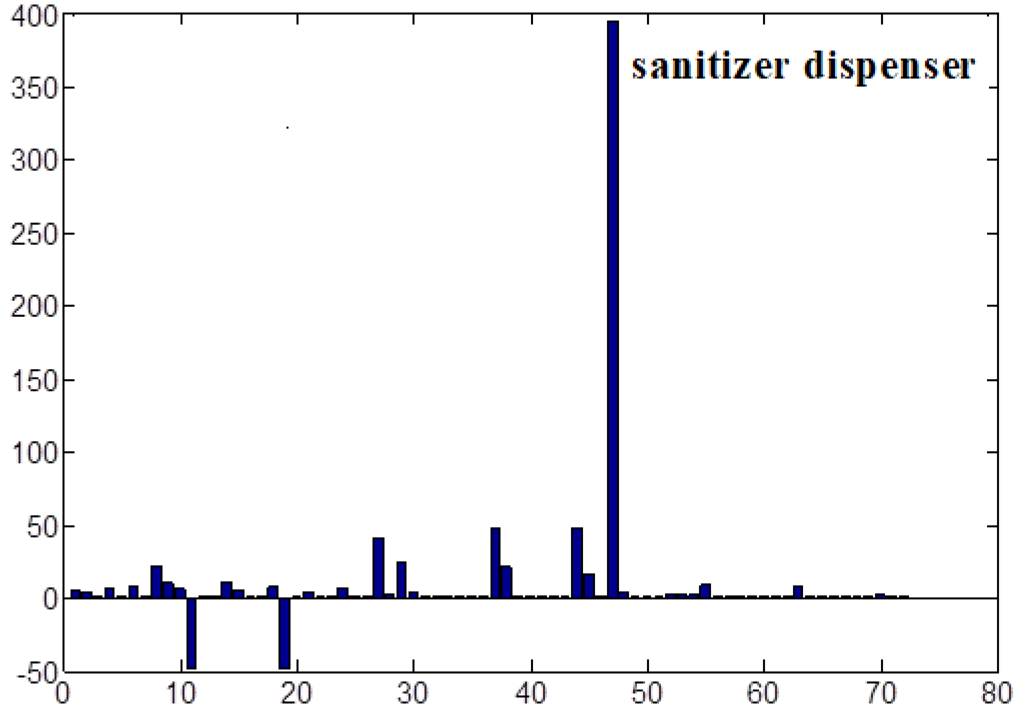

Figure 7 Post-PCA analyses for sanitizer dispenser bar both sides

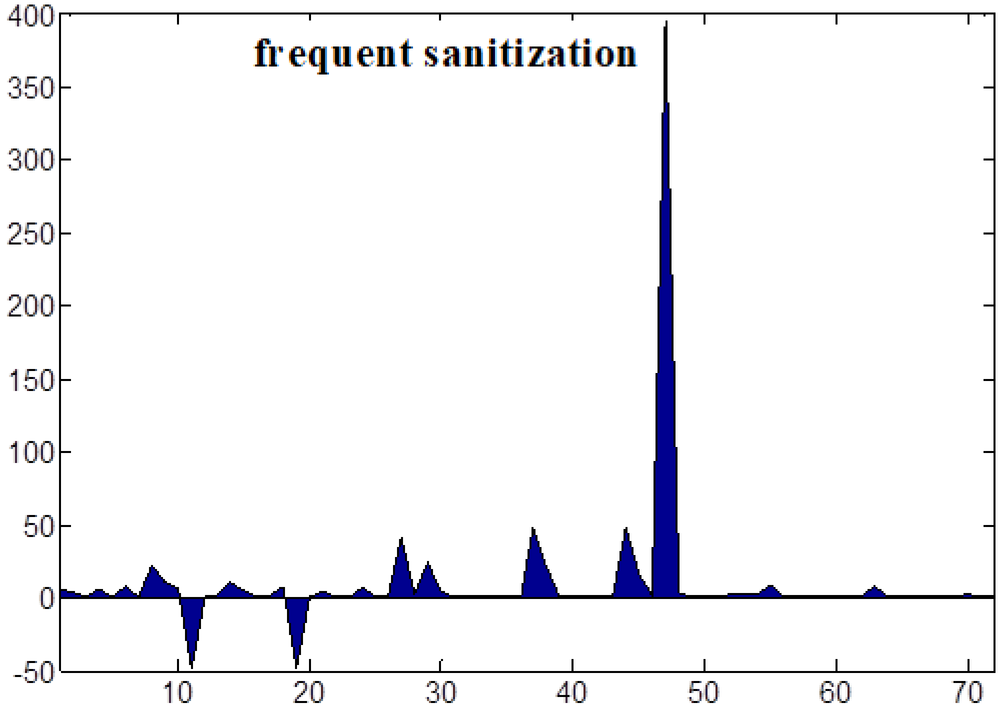

Figure 8 Post-PCA analyses for frequent sanitization

The procedure gives the final percentage for each parameters and validation of control strategy. The PCA results gives the first place in wear mask (90%), second place in sneezing with a tissue (65%), third place in sanitizer dispenser, similarly reaming all parameters in Table 4. Really this method is good for analyses of government control policies. Easily we will get the results from the real life data.

Table 4 Parameters validations % compare to real life data

S.No	Parameters	Description	Percentage of parameters validations
1	α_1	Social distancing	45%
2	α_2	Wear mask	90%
3	α_3	hand gloves	35%
4	α_4	thermal screening	40%
5	α_5	frequent hand washing with soap	31%
6	α_6	sneezing with a tissue	65%
7	α_7	sanitizer dispenser	55%
8	α_8	frequent sanitization	25%
9	α_9	Quarantine for 14 days	39%

5. CONCLUSIONS

We have checked the 9 parameters percentages from government control polices. We verify the good parameter (high %) from the real life data. This pre and post COVID-19 data analyses for PCA is useful for Indian government and other researchers in the area of analyses in COVID-19.

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