

## Supplementary Information

### **Quantification of health benefits due to variation in levels of respirable particulates during phases of COVID-19 lockdown in Delhi-NCR and four non-attainment cities of Uttar Pradesh in Northern India**

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#### List of Tables

**Table S1.** Details of the restrictions and relaxation provided by the Government of India during different phases of lockdown in India

**Table S2.** Details of the stations and number of data points (from  $n = 92$ ) used for calculation in this study from different stations

**Table S3.** Meteorological parameters for all cities

**Table S1.** Details of the restrictions and relaxation provided by the Government of India during different phases of lockdown in India

	<b>Activities Restricted</b>
<b>Activities which was closed during all 4 phases</b>	<ul style="list-style-type: none"> <li>• Restaurants, hotels, and other hospitality services were closed.</li> <li>• Cinema halls, shopping mall, gyms, swimming pools, theatres, bars, and similar places were closed</li> <li>• All gathering (social/sports/entertainment/academic/political/religious/cultural) was suspended.</li> <li>• All domestic and international air travel of passengers was suspended.</li> <li>• All institutions, which included schools, educational or training or coaching institutes, colleges were closed.</li> </ul>
<b>Phase 1 (25 March – 14 April)</b>	<ul style="list-style-type: none"> <li>• All offices of the Government of India and respective state/Union territory was closed. (Exception – Defence, Police forces, treasury, public utilities, disaster management, power generation &amp; transmission units, post offices, municipal bodies, water &amp; sanitation services, Hospitals, and all related medical establishments)</li> <li>• All Commercial and private establishments were closed (Exception: Print &amp; Electronic Media, shops dealing with essential food items, delivery of essential goods through E-commerce, Internet services, telecommunications, Banks, Cold storage &amp; warehouses)</li> <li>• All industrial establishment was closed except manufacturing units of essential commodities and production units which requires continuous process)</li> <li>• All transport services (Air, Road, and Rail) was suspended (Exception: Transportation for essential goods, fire, law &amp; order, and emergency services). However, the movement of people related to essential services was allowed.</li> </ul>

<p><b>Phase 2</b> <b>(15 April – 3 May)</b></p>	<ul style="list-style-type: none"> <li>• All government offices were closed, and all lockdown guidelines for offices was similar to phase 1.</li> <li>• For commercial and private establishments, guidelines were similar to phase 1 except some restriction was uplifted for farming-related activities (the farming operation was allowed, operation of aquaculture industries was allowed, shops of agricultural machinery were allowed)</li> <li>• All industrial establishment was closed except manufacturing units of essential commodities and production units, which requires a continuous process, Mining related activities, packaging industry, Farming industry, and tea industry.</li> <li>• The restriction was uplifted on the movement of trains, airports, and seaports for cargo, relief, and evacuation. Interstate movement of cargo (via air, rail, and road) was allowed. Other guidelines for transport services remained the same as phase 1.</li> </ul>
<p><b>Phase 3</b> <b>(4 May – 17 May)</b></p>	<p>All cities were classified into three zones as per the number of active cases of COVID-19.</p> <p>Green Zone: Districts with zero confirmed cases</p> <p>Red Zone: District with a high number of cases</p> <p>Orange Zone: Districts that are neither defined as green zone nor the red zone.</p> <p>Following restriction was applied in all zones</p> <ul style="list-style-type: none"> <li>• Movement of interstate buses</li> <li>• All type of institution, hospitality services, and gathering</li> <li>• Movement of individuals for all non-essential activities was prohibited from 7 pm to 7 am.</li> </ul> <p>Activities permitted in Red Zone (as all our cities fall under this category)</p> <ul style="list-style-type: none"> <li>• Construction activities in urban areas and rural areas</li> <li>• Industrial activities were permitted in special economic zones, industrial townships, and other industries with proper norms.</li> <li>• Standalone shops were allowed to open.</li> <li>• Private offices can operate up to 33% of the strength.</li> <li>• Movement of individuals and vehicles was allowed for permitted activities.</li> </ul> <p>All other guidelines remained the same as phase 1 &amp; 2.</p>
<p><b>Phase 4</b> <b>(18 May – 31 May)</b></p>	<ul style="list-style-type: none"> <li>• Intrastate movement of Buses and private vehicles were allowed without any special conditions</li> <li>• No movement of individuals from 7 pm to 7 am</li> <li>• Opening up of Government offices with a 50% workforce.</li> <li>• Other guidelines were similar to Phase 3.</li> </ul>

**Table S2.** Details of the stations and number of data points (from n = 92) used for calculation in this study from different stations

<b>City</b>	<b>Station Name</b>	<b>Number of data points used (per year)</b>
<b>Agra</b>	Sanjay Place	91
<b>Kanpur</b>	Nehru Nagar	87
<b>Lucknow</b>	Central School	91
	Lalbagh	92
	Talkatora	90
<b>Varanasi</b>	Ardhali Bazar	91
<b>Delhi</b>	Patparganj	90
	Jahangirpuri	92
	Nehru Nagar	92
	Punjabi Bagh	89
<b>Ghaziabad</b>	Vasundhara	90
<b>Noida</b>	Sector 125	86

**Table S3.** Meteorological parameters for all cities

		Phase 0		Phase 1		Phase 2		Phase 3		Phase 4	
		2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
<b>Agra</b>	<b>WS</b>	2.54 ± 0.78	2.02 ± 0.79	2.27 ± 0.82	2.53 ± 0.81	2.44 ± 0.92	2.38 ± 0.66	3.08 ± 0.51	2.27 ± 0.67	2.50 ± 0.79	2.86 ± 0.99
	<b>RH</b>	53.42 ± 10.19	61.43 ± 11.53	40.72 ± 5.43	45.11 ± 11.43	39.31 ± 13.48	46.25 ± 10.19	32.59 ± 6.45	44.92 ± 7.89	37.53 ± 8.43	38.69 ± 16.54
	<b>AT</b>	26.70 ± 0.33	28.54 ± 0.40	26.74 ± 0.28	28.27 ± 0.21	27.96 ± 0.79	27.88 ± 0.25	28.28 ± 0.49	27.75 ± 0.19	28.43 ± 2.78	28.18 ± 0.28
<b>Kanpur</b>	<b>WS</b>	2.29 ± 0.69	2.06 ± 0.76	1.93 ± 0.80	2.19 ± 0.72	2.31 ± 0.93	2.24 ± 0.81	2.49 ± 0.50	1.63 ± 1.09	2.24 ± 0.71	1.12 ± 0.55
	<b>RH</b>	62.98 ± 8.29	74.55 ± 7.97	55.77 ± 4.78	53.44 ± 6.53	52.91 ± 9.61	62.76 ± 8.25	46.01 ± 6.42	65.94 ± 10.57	49.36 ± 5.20	61.42 ± 11.83
	<b>AT</b>	34.51 ± 1.12	34.74 ± 0.65	35.12 ± 2.26	38.23 ± 3.89	36.01 ± 3.23	36.57 ± 0.98	33.87 ± 1.16	37.92 ± 3.37	34.11 ± 0.91	41.10 ± 3.80
<b>Lucknow</b>	<b>WS</b>	0.63 ± 0.16	0.53 ± 0.09	0.59 ± 0.12	0.65 ± 0.18	0.64 ± 0.17	0.65 ± 0.07	0.72 ± 0.11	0.63 ± 0.05	0.67 ± 0.15	0.63 ± 0.08
	<b>RH</b>	49.77 ± 12.14	68.34 ± 10.67	43.62 ± 8.38	38.83 ± 13.31	37.85 ± 12.62	53.32 ± 12.07	25.66 ± 7.93	57.52 ± 14.26	31.12 ± 7.39	46.50 ± 17.94
	<b>AT</b>	22.31 ± 3.07	22.05 ± 2.44	30.35 ± 3.05	27.99 ± 2.76	32.18 ± 3.54	29.21 ± 2.03	34.44 ± 1.30	30.05 ± 2.85	35.20 ± 1.92	33.20 ± 3.14
<b>Varanasi</b>	<b>WS</b>	1.62 ± 0.45	1.75 ± 0.86	2.15 ± 0.88	1.86 ± 0.56	2.11 ± 0.88	2.72 ± 0.75	1.85 ± 0.42	2.34 ± 0.81	2.13 ± 0.64	2.92 ± 0.76
	<b>RH</b>	46.01 ± 7.39	62.18 ± 7.91	42.25 ± 8.44	36.47 ± 7.91	36.71 ± 11.48	51.62 ± 8.73	25.02 ± 5.36	49.79 ± 9.29	31.40 ± 7.13	45.87 ± 13.05
	<b>AT</b>	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
<b>Delhi</b>	<b>WS</b>	0.81 ± 0.18	0.82 ± 0.34	0.78 ± 0.21	0.79 ± 0.18	0.89 ± 0.37	0.99 ± 0.40	0.80 ± 0.10	0.85 ± 0.27	0.71 ± 0.16	0.96 ± 0.55
	<b>RH</b>	53.09 ± 11.24	63.67 ± 6.77	39.30 ± 6.95	49.89 ± 8.89	32.38 ± 11.48	47.73 ± 8.19	29.38 ± 12.39	50.13 ± 7.19	29.41 ± 12.73	41.18 ± 13.77

	<b>AT</b>	20.11 ± 2.85	19.83 ± 2.01	28.57 ± 2.64	27.15 ± 3.23	31.19 ± 3.86	30.17 ± 1.33	32.15 ± 2.51	30.78 ± 1.72	33.18 ± 2.89	35.25 ± 3.44
<b>Ghaziabad</b>	<b>WS</b>	1.54 ± 0.42	2.21 ± 0.88	1.35 ± 0.51	2.54 ± 0.81	1.45 ± 0.58	3.47 ± 2.79	1.49 ± 0.24	5.61 ± 5.44	1.41 ± 0.32	2.89 ± 0.85
	<b>RH</b>	61.46 ± 9.37	71.04 ± 7.53	50.37 ± 6.24	55.79 ± 10.27	43.79 ± 11.2	55.31 ± 10.31	35.77 ± 9.86	56.70 ± 8.20	43.18 ± 12.02	45.63 ± 18.57
	<b>AT</b>	22.44 ± 2.71	22.95 ± 2.67	30.67 ± 2.54	28.32 ± 2.98	33.29 ± 3.81	31 ± 2.12	35.25 ± 1.97	32.14 ± 2.04	35.55 ± 3.42	35.57 ± 4.52
<b>Noida</b>	<b>WS</b>	1.27 ± 0.32	1.15 ± 0.31	1.2 ± 0.39	1.40 ± 0.34	1.36 ± 0.41	1.39 ± 0.49	1.44 ± 0.26	1.26 ± 0.36	1.23 ± 0.25	1.50 ± 0.42
	<b>RH</b>	60.05 ± 10.06	68.37 ± 8.97	48.20 ± 6.47	52.46 ± 9.82	41.35 ± 11.80	54.24 ± 11.61	37.63 ± 11.59	53.73 ± 12.02	40.47 ± 11.57	41.39 ± 17.74
	<b>AT</b>	20.50 ± 2.73	21.43 ± 3.04	28.60 ± 2.49	26.67 ± 2.82	31.27 ± 3.98	29.55 ± 2.39	32.10 ± 2.19	30.24 ± 3.29	33.43 ± 2.99	33.84 ± 4.02

**WS**- Wind Speed (unit: m/s)

**RH**- Relative Humidity (unit: %)

**AT**- Ambient temperature (unit: °C)

**WS** shows negative correlation of 0.24 and 0.32 with respect to **PM<sub>2.5</sub>** for NCR (Delhi, Ghaziabad and Noida) and non-attainment UP cities (Agra, Kanpur, Lucknow and Varanasi) respectively for year 2020 and both correlations are significant at p< 0.01