

# “Face Mask Use and Disposal Practices during COVID-19 Lockdown in India: Online Survey Report”

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## Abstract

Use of protective face mask is recommended to prevent/ reduce COVID19 (SARS- CoV-2) human to human transmission. However, situation analysis of rational of use in view of different guidelines and its implementation at ground level, availability of mask, use, public perception, and disposal methods is required. Hence this online survey from literate population of 1019 adults across India from high and upper middle group (mean age 26.4 years) was conducted during lockdown April- May2020. High awareness (99.7%) and use (99.6%) of mask is reported, however mask disposal knowledge was found to be low as only 44.4% were doing waste segregation while using non-biodegradable mask. As such bio-waste may become potential reservoir for secondary transmissions, hence require attention and public education. If measures are not undertaken, 11.7 lakh Kg of non-biodegradable waste and through this  $7.8 \times 10^{16}$  virus copy anticipated to spread in environment per day. Despite limitation of design, language and representation of all this study provides matching assumptions on biomedical waste burden.

**Key words:** Face mask, Bio-waste, Use of mask and disposal

## Introduction

Knowledge and community participation is important tool for prevention during pandemic situation of SARS-CoV-2 [1]. Only online spread of knowledge and gather information is possible during Lockdown situation in India, hence it has been adopted in this study. COVID-19 virus is minute in size (65–125 nm) primarily transmitted between people through respiratory droplets particles size >5-10 μm in diameter when a person is in close contact (within 1 m) with someone who has respiratory symptoms (e.g., coughing or sneezing) [2].

There are three types of masks widely in use-namely cloth mask, medical Mask (surgical) and respirators (N95). General recommendation is for Medical masks in low-risk

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situations, and respirators for high-risk situations. Filtering face piece (FFP) masks are also called respirators. The use of respirator such as N95 or FFP2 or FFP3 is significant while performing any aerosol generating procedure in hospital

Research has shown that particles of 0.04 to 0.2 μm “Can penetrate surgical masks.” Surgical face masks protect against COVID-19 droplet transmission but do not protect against aerosolized small particles. Still some research indicates that surgical face masks could prevent transmission of human coronaviruses and influenza viruses from symptomatic individuals’[3]. For the coronavirus responsible for SARS, particles were estimated to be within that range at 0.08 to 0.14 μm (enveloped RNA virus with 80-160 nm in size, average 120nm diameter with spike like projections on its surface) [4].

N-95 masks are so named because they block 95% of particulate aerosols from penetrating the mask [5] and reported to give better protection[6] against droplet and airborne transmission of particles more than 0.3 microns

in size. However it is costly, use is not comfortable. Recent Met-analysis of 6 RCTs on 9171 participants compared surgical versus N95 mask showed non- superior benefit over surgical mask [7,8] hence was not recommended for low risk & general public use [8].

Discussing rational use of face masks in the SARS-CoV-2 (Covid 19) pandemic [9] there is discrepancy on enforced compulsory face mask policies in indoor/private/within house/public/outdoor areas. Majority guidelines has adopted a risk-based approach in offering recommendations for using face masks among health-care workers and the general public [10]. Though initial advice from experts to the general public was not to use a mask in community settings unless they are sick or taking care of someone sick, the advice had to be modified later. Though CDC Atlanta currently advises everyone with no symptoms to wear cloth masks in the community. WHO opines there is no clear evidence to advice for or against mask use in the community, however, encourages countries who are advising community mask use as per moderate, low risk definition of WHO - Moderate risk-areas of high population density (eg, hospitals, train stations), contact of quarantined and administrative staff, police, security, and couriers' staff for COVID-19 samples? Low risk of infection is high population density (eg, supermarket, shopping mall), indoors of medical institutions (other than fever clinics), school students. Very low risks are those who mostly stay at home or doing outdoor activities at work in open or studying in well-ventilated areas.

Initially, WHO as well as Government of India [11] recommended that people should wear face masks if they have respiratory symptoms or if they are caring for somebody with symptoms, or if health-worker attending to patients with respiratory symptoms. However high population density, difficult distancing, identification of asymptomatic carriers, and social stigmatization is there in country like India. One advantage of universal use of face masks is that it prevents discrimination of individuals, may reduce viral load if everybody is wearing a mask.

Some Community based face mask use recommendations [12]:

- **WHO:** Only who are taking care of infectious cases
- **China:** Surgical mask for moderate risk and any / cloth mask for low risk/ no mask outdoor
- **Hong Kong:** Surgical mask during outdoor
- **Singapore:** Wear mask only when respiratory symptoms
- **Japan:** Wear mask only in ill ventilated/ indoor/ hospital zones/ not outdoor
- **USA:** No mask required for healthy people

- **UK:** No need of mask in public places/ outdoor for healthy people
- **Germany:** No need of mask for healthy persons
- **India:** Low risk Healthy persons are to use homemade cloth mask indoor/ outdoor even when asymptomatic or healthy.

### Material of Mask

Surgical masks are made up of two-three layers of polypropylene using mechanical impaction as method of filtration. Three layers are made from a melt-down material placed between non-woven fabrics. The melt down material acts as the filter. N95 have four to five layers of polypropylene sandwiched with charged polypropylene layer. The combination of mechanical impaction and electrostatic capture is utilized for filtration of aerosols. The material of the mask is mostly non-biodegradable as N95 is comprised of layers of spun-bound polypropylene, the second layer of 8 cellulose/polyester, the third layer of melt-down polypropylene and inner and fourth layer of spun-bound polypropylene.

### Disposal

Used masks must be disposed very carefully as per guidelines- as it can act as a source of infection for the other people who come in contact with this material either intentionally or accidentally. According to the recommendations by WHO, the mask should be discarded in the following manner- after removal of mask, it should be folded twice so that the infected surface is not exposed outside, collected it in leak proof containers carefully sealed and transport to a central storage facility by a method that prevents direct contact. After folding the mask, it should be discarded in the closed bins. Specifically, biohazard marked disposal bin bags maybe used for the disposal in hospital settings. Precautions should be taken while collecting the waste from locations such as hospitals, airports, and from community settings. Provisions should be made not to mix the biomedical waste collected from different sources. They must either be incinerated or be disinfected preferably by autoclaving before final disposal.

The respiratory masks or disposable masks may be treated with autoclaving, vapourous hydrogen peroxide (VHP) exposure, ethylene oxide (EtO), peracetic acid and dry fogging system (PAF) or low temperature hydrogen peroxide gas plasma (LT-HPGP) treatment. Study conducted by Canadian researchers have shown that two or more cycles of LT- HPGP treatment to N95 masks is effective in hampering the structural integrity and function of the respirator. Hand washing should be done before reusing. For home made cloth mask for community use should be washed with soap and water and dry for 5 hrs before reuse,

or boil in pressure cooker for 15 minutes, or hot iron press. Keeping in sealed plastic pack before reuse is advised.

High awareness on mask use has been reported among Indians during ongoing countrywide lockdown due to COVID 19 (SARS- CoV-2) crisis [13,14] with more than 80% awareness and 36.6% using protective masks. However, knowledge of its type, cost incurred, availability, use and disposal mechanism are not studied in Indian context. Most crucial aspect is safe disposal of such infective materials, as improper disposal may lead to transmission of infection.

Proper use and disposal of such material cannot be controlled in community settings in India where all sorts of waste are mixed and not disinfected before final dumping at landfill sites. Used masks may go to landfills without segregation and recycling or disinfecting. This type of waste may become breeding ground for parasites for outbreaks in the upcoming humid rainy season. A study by environmental group have found thousands of masks littering beaches and hiking trails in Hong-Kong, where they pose a threat to marine, animal and bird life [14]. Some masks could have been used by infected individual and worrying threat for long duration. The masks made of polypropylene, a type of plastic and are not going to break down quickly; hence there is need to be prepared for the management of medical waste generated. There are risks of spread of virus through garbage collectors and if the management of infected waste is not followed properly by community. Seeing community education importance, this study was conducted to elicit knowledge, practice, and point of view on disposal from the Indian community.

## Methods

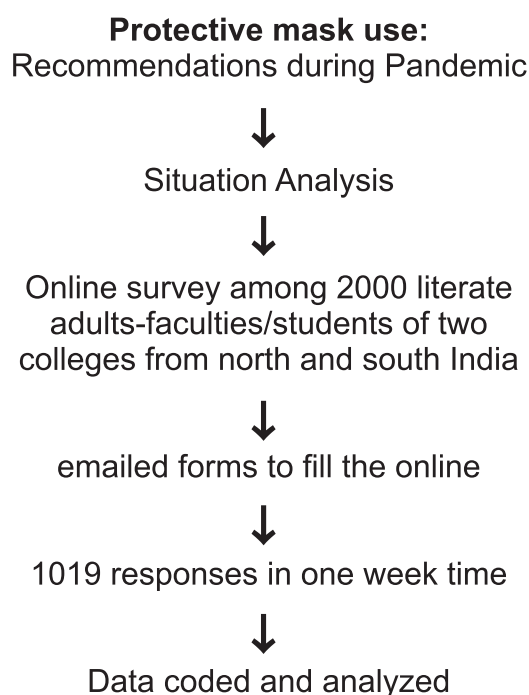
This online survey was conducted using Google forms during lockdown of April-May 2020. The questionnaire was planned using a semi-structured questionnaire with choice of not to answer any question. An issue of mask use, its availability, disposal methods among asymptomatic general population was covered during this cross-section survey using a non-probability snowball sampling technique. A total of 1019 responses gathered and analyzed on SPSS version 20 and excel sheet using frequency tables and chi-square test.

Age above 18 years and written inform consent was first part to fill the form. The 21-items questionnaire was internally validated for clarity and circulated using means of whatsapp, and emails majorly among the educational institution faculties, their families and students across India. After demographic profiling, initial 20 questions were with multiple choice options with only one correct answer for KAP section. Last part of questionnaire invited ideas, and concerns in free text form. Responses are grouped as

demographic profile, KAP and 8 major categories of qualitative data on ideas and concerns.

Participants with access to the internet could participate in the cross-sectional survey. Equal representation from north and south India received. Participants with age more than 18 years, able to understand English and willing to give informed consent participated. Data collection was initiated on 22 April 4 pm IST and closed on 4<sup>th</sup> May 2020 4 PM IST. Ethical committee certificate exempted for such category is considered least risk with no personal identification of responders.

## Flow diagram



## Results

A total of 1019 participants with mean age of 26.4 years responded to the questionnaire. The age of participants ranged from 18-74 years. 70% responders were male. Majority of participants were professionally qualified or graduates of college (76%) by education, students (52.1%), Government Job (14.8%), or in Private Job/Business (22.7%) by occupation. Around 67.2% responders were in upper middle- and high-income class (Table 1). Overall awareness of participants on SARS, CoV-2 was 95%. Almost all participants (97%) were aware of the mechanism of spread. Majority were using face mask outdoor only (71.7%). The details of participant's responses on knowledge about SARS, CoV-2 are presented Pie charts 1-14.

**Table 1: Demographic profile of the participant's (n-1019)**

<b>Age in years</b>	<b>N</b>	<b>%</b>
18-25 years	741	72.8
26-60 years	247	24.2
61-80years	5	.5
Did not answer	26	2.6
<b>Total</b>	<b>1019</b>	<b>100.0</b>
<b>Gender</b>		
Male	716	70.3
Female	290	28.5
Did not answer	13	1.3
<b>Total</b>	<b>1019</b>	<b>100.0</b>
<b>Education</b>		
Professional	123	12.1
Graduate/postgraduate	651	63.9
Primary	132	13.0
Student/pursuing PhD	50	4.9
No response	63	6.2
<b>Total</b>	<b>1019</b>	<b>100.0</b>
<b>Monthly Family Income (Indian Rupees)</b>		
>50000	365	35.8
up to 50000	320	31.4
up to 10000	250	24.5
Did not answer	84	8.2
<b>Total</b>	<b>1019</b>	<b>100.0</b>
<b>Employment</b>		
Government job	151	14.8
Private job	166	16.3
Home maker	17	1.7
Business	65	6.4
Unemployed	531	52.1
Did not answer	89	8.7
<b>Total</b>	<b>1019</b>	<b>100.0</b>
<b>Monthly medical expenses (Indian rupees)</b>		
up to 1000	550	54.0
up to 5000	203	19.9
>5000	82	8.0
>10000	40	3.9
>25000	30	2.9
Did not answer	114	11.2
<b>Total</b>	<b>1019</b>	<b>100.0</b>

**Table 2: Knowledge attitude and Practice of Masks use and Disposal**

<b>Q. Are you aware of COVID-19 infection and its spread</b>	<b>N-1019</b>	<b>%</b>
Yes	965	94.7
No	33	3.2
Did not answer	21	2.1
<b>Q. What do you think it spreads by? (May choose multiple options)</b>		
Don't want to answer	17	1.7
Body fluid of infected person/ cough/ sneezing	3	.3
Body touch	64	6.3
Droplets, infected air	17	1.6
infected surface	182	17.8
Possible through all the above modes	723	71.0
Not sure of mechanism	13	1.3
<b>Q. Are you using a face mask yourself?</b>		
No, Neither indoor nor outdoor	34	3.4
Both indoor and outdoor	243	23.8
Indoor only	11	1.1
Outdoor only	731	71.7
<b>Q. Indication for Mask use / by whom it should be used</b>		
No idea	62	6.1
Mask is helpful for person having symptom of cough, fever, sneezing, cold, or difficult breathing symptoms, medicos	56	5.5
Mask id helpful to protect when going out of house	208	20.4
It will help to all symptomatic, asymptomatic everywhere	693	68.0
<b>Q. What type of mask(s) are you using?</b>		
Don't know type	51	5.0
Cloth/ towel/ handkerchief/ dupptta/ home made	356	34.9
N-95/ respirator	128	12.6
Triple layer/ industrial dust proof / surgical mask	293	28.8
Combination of all above	191	18.7
<b>Q. From where did you get/buy the masks?</b>		
Don't wish to answer	182	17.8
From office/ company	57	5.6
purchased from medical shop/ super market/chemist/ pharmacy	562	55.2
Online purchase	30	2.9
Government provider	20	2.0
Using self-made mask so no need to purchase	168	16.5
<b>Q. In case you bought your mask, what was the cost? (in Indian Rupees)</b>		
Nil	354	34.7
up to 10 Rs	66	6.5
up to 30 Rs	119	11.7
21-50 rs.	256	25.1
51-100 rs.	86	8.4
101-200 Rs.	60	5.9
201-300 Rs.	42	4.1
301-400 Rs.	24	2.4
>400 Rs.	12	1.2

<b>Q. Frequency of discarding the used mask</b>		
Do not wish to disclose	67	6.6
Daily	298	29.2
Reusing the same mask	345	33.9
Weekly	309	30.3
<b>Q. Do you disinfect your mask to prepare it for reuse</b>		
Yes	758	74.4
No	190	18.6
Did not answer	71	7.0
<b>Q. Place of disposing off or throwing used mask</b>		
Don't want to disclose the place of disposal	178	17.5
Throw anywhere away from house	6	.6
Washing/ reusing so not discarding anywhere	29	2.8
Dustbin at Home/ public bins	611	60.0
Hospital Bio-waste bin	56	5.5
Disinfecting/ Burning	139	13.6
<b>Q. Methods, If you dis-infect your mask?</b>		
No response	85	8.3
Not disinfecting at all	92	9.0
Chemical disinfectant	192	18.9
Drying	73	7.2
Washing	577	56.6
<b>Q. What do you think- the mask is usable and the safest when-</b>		
No Idea	70	6.9
Reused after drying	55	5.4
Reused after soaking into disinfectant	300	29.4
Reused after washing	306	30.0
New mask is used every day	288	28.3
<b>Q. Do you segregate Biodegradable at your house?</b>		
Yes	654	64.2
No	252	24.7
Did not answer	113	11.1
<b>Q. Is your mask</b>		
Non-biodegradable	228	22.4
Biodegradable	687	67.4
No idea	104	10.2

Majority responders considered that mask helps in prevention of virus spread, and should be used irrespective of presence disease. Only 6.1% had no idea of benefits. Majority responders reported using homemade cloth mask (34.9%) or disposable surgical mask (27.6%) and 5% were not knowing type of mask but using it. Nearly half (55.2%) purchased mask from nearby shops @INR 10-50 by majority (43.3%). Only 25.5% got it free from company, office/family or from Government. One third responders disposed masks daily and one third weekly and 24.6% were not disinfecting before reuse. Major place of disposal was

bin in house or public bin. Washing was most common mode of disinfection before reuse (56.6%). Segregation (biodegradable/ non-biodegradable) according to type of waste was not done by 35.8% responders.

Nearly two third participants (n-712) responded for last question-ideas / comments section. Major concerns were related to (1.) Shortage of mask supply (34%); (2.) High price (80%); (3.) Need of more research on use of different masks (18%); (4.) Mechanisms to ensure home delivery of low-cost masks and disinfectants to sterilize masks (32%); (5.) Need to create facilities for safe disposal, special

plants for disposal, recycling of non-biodegradable bio-waste (23%). Ideas were given for homemade cloth mask by 285 participants.

113 participants (11%) not included in Table-2 analysis (only 906 included) due to non-response on either on type of mask or question on waste segregation. 66.3% who were using non-biodegradable mask were not segregating waste. 252 (27.8%) of 906 found not doing segregation of waste at home.

All homemade masks 427 (65.1%) are considered under biodegradable. 42% using non-biodegradable masks reported that their masks as biodegradable, and 10.4% were not aware of biodegradability status of masks.

### Load of Waste

Considering 3 to 5 Gram weight of one face mask and 612 (60%) users of non-biodegradable masks among 1019 users, makes it 1.8 Kg to 3.0 Kg of non-biodegradable bio-waste from 1000 users. Considering population of India as 1.3 billion, and half of them using non-biodegradable masks, makes approximately  $1.8/1000 \times 65,00,00,000 =$  eleven lakh seventy thousand Kg (11.7 Lakh Kg) of non-biodegradable face mask bio-waste to be handled per day.

### Load of Virus

Estimates of viral load through unplanned disposal of non-biodegradable masks is done considering 50% persons

shedding respiratory viruses during regular breathing [3] containing load of  $10^8$  virus per nasal swab sample (here per face mask) makes it 0.78 billion Indians (60% of 1.3 billions)  $\times 10^8 =$  emitting  $7.8 \times 10^{16}$  virus copy numbers in the environment if mask goes to disposal in unplanned manner.

### Discussion

During influenza pandemic 2003-7, mask and UV light were tested for prevention [15] and during ongoing SARS CoV-2 pandemic, Mask use has been part of prevention strategy. In theory, masks N-100 respirators are 99.999% found effective in filtering particles of more than 120 nm in size. Respirators are also effective against particles much smaller in size (40-50 nm) hence the influenza virus of 80 to 120 nm in size is supposed to be prevented. Studies of successful prevention [16] by masks as well as failed effect [17-22] of use of masks are prevailing and need large multi country validation however currently during lockdown what can be done on account of community practice needs to be looked into. With reference to COVID-19, a recent report from China revealed that a patient had infected five others while travelling in a vehicle without a face mask, whereas no one was infected in a second vehicle in which the patient travelled while wearing a mask [18-19]. Overcrowding during the Hajj mass gatherings is associated with increased risk of spreading respiratory diseases. Non-pharmaceutical interventions (e.g., hand hygiene, wearing face masks,

**Table 3: Waste segregation practices**

Type of mask in use	Segregate waste	Do not Segregate	Total
No response	16 (2.4%)	9(3.6%)	25
Homemade- Cloth/ duppatta	231(35.3%)	85(33.7%)	316
N-95	84(12.8%)	32(12.75)	116
Triple layered/Surgical	188(28.7%)	79(31.4%)	255
Combination	135(20.6%)	47(18.75)	182
Total responses	654	252	906

**Table 4: Knowledge about bio degradability**

Type of Mask	Don't know about biodegradability	Non biodegradable	Biodegradable	Total
No response on mask	25, 24.0%	12, 5.3%	14, 2.0%	51,5%
Homemade Cloth/ Duppatta/ Triple layer/ surgical mask	30,28.8%	66,28.9%	260,37.8%	356, 34.9%
N-95	24,23.1%	83,36.4%	186,27.1%	293, 28.8%
Combinations	13,12.5%	22,9.6%	93,13.5%	128,12.6%
Total	12,11.5%	45,19.7%	134,19.5%	191,18.7%
	104(10.4%)	228 (22.4%)	687 (67.4%)	1019

social distancing) reduced/ prevented Flu like illness (FLIs) among Hazi as 31% had FLIs in masked group versus 53% on no mask,  $p= 0.04$  [19]. Amidst debatable effectiveness of use of protective mask, it is recommended because any type of general mask use is likely to decrease viral exposure and infection risk in community level.

In the study, comparing transmission reduction by personal respirators, surgical masks and home-made masks (when worn during a variety of activities by healthy volunteers and a simulated patient) all types of masks found reducing aerosol exposure, relatively stable over time, unaffected by duration of wear or type of activity, but there was high degree of individual variation also.

Awareness is observed as no issue in our and others studies. In this internet era and with wide outreach of television even in rural area 80.8% of the population responded that the route of transmission of virus is via inhalation and 83.2% were using face mask to prevent swine flu in the study published in 2018 [20]. Slightly higher use is observed in our study with 96.6% responders using masks, but they all are urban literate high, middle income groups.

Issue of disposal in community setup is a concern. Mitigation measures for safe disposal of used masks are part of guidelines but implemented at community level has not been good. Infectious disease physician Ben Killingley has said that among several reasons why masks were not seen as effective in the community as people "Find it difficult to be compliant with mask use all of the time and that people may start wearing the masks too late." The other problem may be that the public did not have the resources to ensure safe mask use: changing them often, frequent hand hygiene during removing and disposing of them safely. Similar needs for safe disposal education highlighted by responders in our study in idea column.

Handling the waste mask has been concern in many community and hospital waste studies [21]. Attempts to find solutions in terms of education of community [22,23] assessing KAP on waste segregation methods and education on cost effective feasible measures [23,24] has shown good impact. In our study, load of such bio-waste and proposed segregation to mitigate risk of secondary transmission infection has been evaluated. Similar attempts to promote waste segregation and proper disposal in other studies [24-28] have reported mitigation and risk reduction.

Our study has lacunae of covering English literate, high / middle income group with mobile phone and internet facility, while majority low middle- and low-income community (without mobile phones) non-English speaking may have different perspectives on use and disposal practices, hence community-based door to door survey may cover that population also. This study majorly covers one educational

institution of north India and one from south India, so not the true representation of the whole country. Data of this study is a sample of a high-income literate community and assumed for worse conditions among those who are not aware, hence highlights gravity of situation.

## Conclusion

This study has highlighted important public perspectives on use of protective face mask, yet compromised disposal. During pandemic situation, implementation agencies in field need to enhance community education on bio-waste management.

## Importance/novelty

This paper highlights important aspects of rationale, public perception and practice of face mask use during pandemic. There is a gap in use and proper disposal knowledge after use and found as a required area of community education which needs to be addressed by SARS-CoV-2 prevention and mitigation agencies.

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<b>Ethics:</b>	There is no ethical violation as it is based on voluntary anonymous interviews
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<b>Guarantor:</b>	Dr. Neeta Kumar will act as guarantor of this article on behalf of all co-authors.

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