A CROSS-SECTIONAL STUDY ON THE ASSESSMENT OF KNOWLEDGE AND METHODS PRACTICED IN DISINFECTING AND DISPOSAL OF FACEMASKS AMONG THE GENERAL PUBLIC

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ABSTRACT

Objectives: The vast amount of facemasks generated as waste should be disposed of appropriately and responsibly to prevent adverse effects on health and the environment. This study aims to assess the knowledge and methods commonly practiced by the public to disinfect and dispose of used facemasks.

Methods: A cross-sectional study was conducted from June 2021 to December 2021 in the South Part of Karnataka using a face-validated questionnaire. The questionnaire included subject demographic details and methods to disinfect and dispose of masks. The data were recorded and analyzed using Microsoft Excel.

Results: A total of (n=501) participants took part in the study. This study observed that the most commonly practiced method was to wash the masks with specific cleaners (n=259, 53%). We also assessed knowledge regarding the methods of disposal of a mask. The majority of the participants in our study are aware of the correct method for disposal of used masks(n=342, 68.26%), while (n=159, 31.73%) of subjects are not aware of the right facemask disposal method. Subjects who are educated (p=0.008) and regular mask users (p=0.011) are aware of the right method for mask disposal.

Conclusion: Many people are unaware of the correct disposal methods. Hence, Manufacturers and Scientists should identify an effective way to disinfect and dispose of used masks and educate the public to practice the proper method of facemask disposal.

Keywords: Facemask, Disposal, Disinfection, Infectious waste, Coronavirus disease 2019, Cross-contamination, Decontamination, Infection, and Viral transmission.

INTRODUCTION

The outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in December 2019 led to several complications; to tackle the condition, many recommendations were made. One of them was to wear a face mask to protect the individuals from acquiring and spreading the SARS-CoV-2 viral infections. In this context, using facemasks has become a mandatory and powerful tool in preventing viral transmission, increasing the consumption of facemasks among healthcare providers and the general public [1]. Although several authorities have established guidelines for the usage and disposal of personal protective equipment (PPE) like medical masks, non-medical masks, face shields, aprons, and gloves, there is poor handling of these types of equipment after their use among the public. Infectious wastes are characterized as any material that is suspected to contain pathogens such as bacteria, viruses, fungi, and/or parasites in sufficient concentration to cause disease in susceptible hosts [2]. This also includes used facemasks contaminated with blood, saliva, body fluids, etc., which have the potential to spread infection [2]. The infectious waste generated during the coronavirus disease 2019 (COVID-19) pandemic is plenty and among them, used facemasks pose the desired habitat for SARS-CoV-2 to establish its wings to the whole world [3]. Millions of contaminated facemasks, gloves, and other PPE are causing serious and irreversible environmental and health problems. The disposal and disinfection of used masks have become major environmental concerns [4]. Hence, there is a need for the deep observation of individual handling of the facemasks. The proper use and disposal of facemasks are essential as the incorrect practices impose not only the spread of disease but also become hazardous to the environment.

METHODOLOGY

This study is a cross-sectional study that was conducted from June 2021 to December 2021 among the population in South Karnataka. Due to the enforcement of COVID prevention protocol, the data were collected by distributing questionnaires through Google forms. The questionnaire was face and content-validated. A total of 501 participants gave consent and participated in the study. The study was initiated after approval from the Institutional Ethics Committee (IEC approval number: PESCP/ETH/84/2022). The data were collected using questionnaires that consisted of respondents' demographic details such as age, gender, qualification, and comorbid conditions which were obtained. Information regarding the types of masks used, regularity of mask use, disinfecting, and disposal of masks after use was recorded. The data were recorded, tabulated, and analyzed using Microsoft excel. A Chi-square test was performed to determine the association between participants' demographics such as age, gender, education, and regular mask use with knowledge about the correct method of mask disposal. $p < 0.05$ was considered to be statistically significant.

RESULTS

In this study, 501 participants gave their consent and completed the questionnaire. Among them (n=244, 49%) respondents were male, and (n=257, 51%) were female. Most of them used masks regularly (n=432, 86%), while (n=69, 14%) participants do not wear masks regularly. Different types of masks are available and their purpose and effectiveness vary from one another. The different types of face masks used by the study participants were cloth masks (n=184, 37%), N95 masks (n=113, 23%), surgical masks (n=42, 8%), and multiple types of masks (n=162, 32%). The present study revealed the different methods practiced by the general public to disinfect masks and dispose of the mask (Figs. 1 and 2). The participants' opinion on the appropriate method of mask disposal is depicted in (Fig. 3). The present study assessed the association between the subject's demographic details and their knowledge regarding the correct

Table 1: Association between participant's knowledge of mask disposal with their demographics

Characteristics	Know the correct method of mask disposal		Chi-square (x^2)	p-value
	Yes	No		
Age				
≥30 years	272	129	0.173	0.677
≥30 years	70	30		
Gender				
Male	167	77	0.007	0.933
Female	175	82		
Education				
≤PUC	30	12	11.889	0.008*
UG	168	101		
PG	143	44		
Uneducated	1	2		
Regular mask use				
Yes	304	128	6.427	0.011*
No	38	31		

*Statistically significant at p<0.05

method of mask disposal. It was found that participants' education (p=0.008) and regularity of mask use (p=0.011) had a statistically significant association with their knowledge about the right method of facemasks disposal (Table 1).

DISCUSSION

The use of masks due to the COVID-19 pandemic in many public places has become mandatory. A huge amount of waste is generated with the excessive use of facemasks. This waste should be disposed of appropriately to prevent adverse effects on health and the environment. A study conducted by Sangkham estimated the daily facemask usage and it was found that in Asia, the total face mask use was 2,228,170,832 [5]. Hence, excessive amounts of mask waste are generated that require proper disinfection and disposal.

In the current study we assessed the different methods practiced by the general public to disinfect masks. The most commonly employed techniques to disinfect masks were to wash with specific cleansers such as soap/detergent (n=259, 53%), wash only with water/ hot water (n=127, 26%), wash with 70% ethanol (n=12, 2%), and perform dry heat (n=7, 2%). In the present study ,few participants responded that they always threw facemasks after use (n=73, 15%), while others never cleaned/disinfect facemasks (n=11, 2%) (Fig. 1). However, Scalvenzi *et al*. carried out a study in Italy to assess the community knowledge about the use, reuse, disinfection, and disposal of masks and filtering facepiece respirators. The frequently used method to disinfect masks was with specific cleansers (n=1112, 43.4%) and using alcohol (n=615, 24%) [6]. The study conducted by Fischer *et al*. showed face masks decontaminated with 11% hydrogen peroxide vapors and dry heat can inactivate the SARS-CoV-2 without destroying the filtering efficiency of the masks [7]. It is observed in our study that rarely participants employed these techniques to disinfect masks as these methods are difficult to perform at the community level by the general public. In the current study, participants revealed the methods commonly followed to dispose of the mask after its use (Fig. 2). Among them, the most widely practiced was to (n=253, 50.49%) collect it in other separated bags (either in organic or paper bags), (n=103, 20.55%) collect separately together with plastics, (n=76, 15.16%) subjects dispose of a used facemask by collecting it together with mixed waste, and (n=57, 11.37%) dispose of wherever available the reason being there is no provision for special bags specific to mask to collect it separately both at household and garbage collectors. Similar findings were reported by Scalvenzi *et al*. study where the majority of patients declared to throw masks
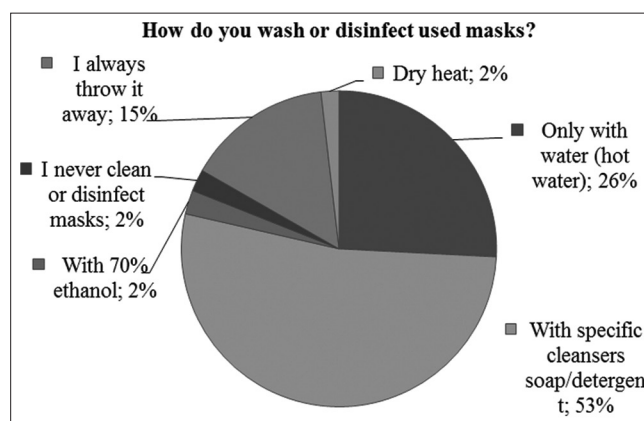

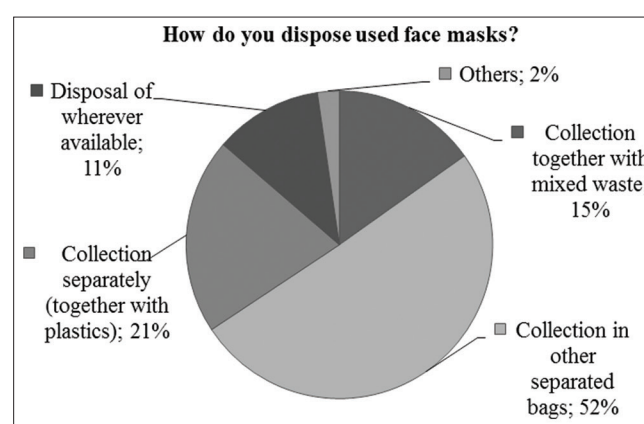**Fig. 1: Participant's response on methods practiced to wash/ disinfect masks after use**

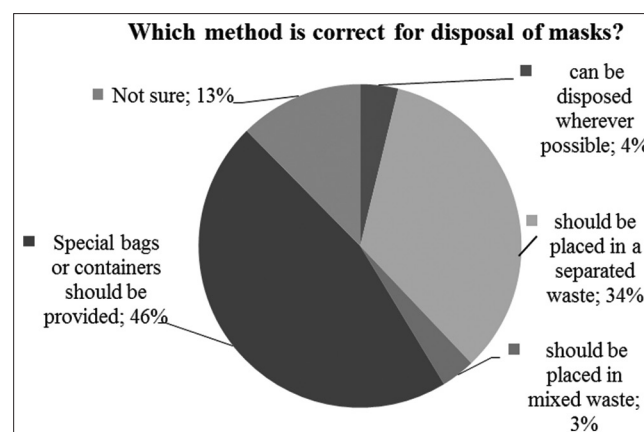**Fig. 2: Participant's response on methods employed to dispose of masks after use**

Fig. 3: Participant's opinion on the appropriate method of mask disposal

in general waste (n=1806, 70.5%), while 13.4% and 11% reported throwing masks away in a specific waste basket (n=343) and the usual waste basket (n=282), respectively [6].

We also assessed their knowledge regarding the methods of disposal of a mask. Most of the participants (n=342, 68.26%) know the correct method for disposal of used facemasks, whereas (n=159, 31.74%) participants do not know the correct mask disposal methods. When we took the participant's opinion on the appropriate method of mask disposal, most of them reported that used facemasks should be placed

in special bags/containers (n=232, 46%) and also suggested that they can also be placed in separated waste (n=171, 34%), while least of them had opinion that used facemasks can be disposed of wherever possible (n=19, 4%) and can also be placed in mixed waste (n=17, 3%). The participants (n=62, 13%) reported that they were unclear about the disposal methods (Fig. 3).

People who are educated are likely to have more knowledge about environmental issues and have the attitude to protect the environment. The positive relationship between education and environmental concerns has been established in the world value survey 2010–2012 and also has shown that a higher level of education increases the concern for the environment [8]. Similarly, in the present study, we found that there was a statistically significant association between the educational qualification of the study subjects and the knowledge about the correct method of mask disposal at p=0.008 (Table 1). This shows that education encourages practicing the right method of mask disposal, which protect both health and the environment. The requirement for face masks increases among people who use masks regularly. Regular masks use leads to an increased amount of waste generation. Those who wear masks regularly should be aware of the proper method of disposal and disinfection of masks to avoid unfavorable consequences. It is evident that there is a highly positive significant association between regular mask use and knowledge to follow appropriate methods to dispose of and disinfect face masks with p=0.011 (Table 1). Despite their busy lives, the study participants employed a safe way to dispose of the used masks. The study by Hirsh J B demonstrated that age is negatively related to environmental concerns [9,10]. The similar trend was observed in the present study that there is no significant relationship between the age or gender of the study subjects and knowledge of mask disposal. However, the study conducted by Soni *et al.* showed a positive association between the age of the respondents belonging to the age group of 19–28, 29–38, and 39–48 years were more vigilant and carefully followed safety measures in handling masks [11].

Used masks are considered to be infectious waste and may contain a variety of pathogenic microorganisms. Pathogens in infectious waste may cause infections in humans [12,13]. In addition, it is also observed that many individuals throw away the mask wherever available after use without disinfecting. Consequently, this may adversely affect the health of humans as these masks are contagious for an approximate period of 7 days and can serve as a medium for viral transmission [14]. On the other hand, incorrect infectious waste disposal has an impact on the environment, which may get deposited in the street, aquatic bodies, and landfills and cause a threat to all creatures [15]. Hence, there is a need for proper education and enforcement of guidelines to implement the right method of mask disposal.

CONCLUSION

The COVID-19 pandemic has necessitated the extensive use of facemasks, which is resulting in an enormous amount of infectious waste. Used masks are considered potentially infected medical waste. Improper disinfection and disposal of these wastes can be both an environmental as well as health hazard. It is important to follow the correct method to disinfect and dispose of used facemasks to avoid cross-contamination, the spread of infection, and to prevent harmful impacts on the environment. In addition, throwing away the mask ignorantly without disinfecting may disturb the health of both garbage pickers and street animals. One must behave responsibly in the disposal of used masks. Hence, it is a pressing priority to identify scientific and effective methods to disinfect and dispose of facemasks, and very important to educate and implement the right practice of mask disposal among the public.

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AUTHORS' CONTRIBUTIONS

Literature search, design, data acquisition, statistical analysis, manuscript preparation, and editing: Pavithra S Sarji. Literature search, design, data acquisition, and statistical analysis: Nagarathna Poojary. Supervisor, literature search, and manuscript review: Dr. Vineela Nekkanti, Dr. R Srinivasan

All the authors have read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

REFERENCES

1. Centers for Disease Control and Prevention. Use and Care of Masks. Georgia, United States: Centers for Disease Control and Prevention; 2022. Available from: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/about-face-coverings.html [Last accessed on 2022 Aug 05].
2. World Health Organization. Safe Management of Wastes from Health-Care Activities: A Summary. Geneva: World Health Organization; 2017. Available from: https://apps.who.ont/iris/bitstream/handle/10665/253491/WHO-FWC-WSH-17.05-eng.pdf?sequence=1 [Last accessed on 2022 Jul 01].
3. Mejjad N, Cherif EK, Rodero A, Krawczyk DA, El Kharraz J, Moumen A, *et al*. Disposal behavior of used masks during the COVID-19 pandemic in the Moroccan community: Potential environmental impact. Int J Environ Res Public Health 2021;18:4382.
4. Dharmaraj S, Ashokkumar V, Hariharan S, Manibharathi A, Show PL, Chong CT, *et al*. The COVID-19 pandemic face mask waste: A blooming threat to the marine environment. Chemosphere 2021;272:129601. doi: 10.1016/j.chemosphere.2021.129601, PMID 33497928
5. Sangkham S. Face mask and medical waste disposal during the novel COVID-19 pandemic in Asia. Case Stud Chem Environ Eng 2020;2:10052.
6. Scalvenzi M, Villani AR, Ruggiero A. Community knowledge about the use, reuse, disinfection and disposal of masks and filtering facepiece respirators: Results of a study conducted in a dermatology clinic at the University of Naples in Italy. J Community Health 2021;46:786-93. doi: 10.1007/s10900-020-00952-3, PMID 33258051
7. Fischer RJ, Morris DH, van Doremalen N, Sarchette S, Matson MJ, Bushmaker T, *et al*. Effectiveness of N95 respirator decontamination and reuse against SARS-CoV-2 virus. Emerg Infect Dis 2020;26:2253-5. doi: 10.3201/eid2609.201524, PMID 32491983
8. Education Increases Awareness and Concern for the Environment. UNESCO Global Education Monitoring Report; 2015. Available from: https://world-education-blog.org/2015/12/08/education-increases-awareness-and-concern-for-the-environment [Last accessed on 2022 Aug 06].
9. Hirsh JB. Personality and environmental concern. J Environ Psychol 2010;30:245-8. doi: 10.1016/j.jenvp.2010.01.004
10. Mobley C, Vagias WM, DeWard SL. Exploring additional determinants of environmentally responsible behavior: The influence of environmental literature and environmental attitudes. Environ Behav 2010;42:420-47. doi: 10.1177/0013916508325002
11. Soni S, Sornapudi SD, Babel S. Use of face masks in India during COVID-19: An exploration of the behavioral tendencies of mask users. Indian Res J Ext Educ 2022;22:73-80.
12. Padmanabhan KK, Barik D. Health hazards of medical waste and its disposal. Energy Toxic Org Waste Heat Power Gener 2019;99-118.
13. Mastorakis NE, Bulucea CA, Oprea TA, Bulucea CA, Dondon P. Environmental and health risks associated with biomedical waste management. Dev Energy Environ Econ 2010;287-94.
14. Ilyas S, Srivastava RR, Kim H. Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. Sci Total Environ 2020;749:141652. doi: 10.1016/j.scitotenv.2020.141652, PMID 32822917
15. Selvaranjan K, Navaratnam S, Rajeev P, Ravintherakumaran N. Environmental challenges induced by extensive use of face masks during COVID-19: A review and potential solutions. Environ Chall 2021;3:10039.