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Management and use of filter masks in the "none-medical" population during the Covid-19 period

Enzo Cumbo, Giuseppe Alessandro Scardina *

Department of Surgical Oncological and Stomatological Disciplines, University of Palermo, Italy

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ABSTRACT

SARS-CoV-2 has become a pandemic disease declared by the World Health Organization, consequently each nation has taken a series of actions managed by the government in order to prevent the spread of this dangerous virus. The most common countermeasure is the use of a mask that should cover the mouth and nose to filter the inhaled and exhaled air. Those masks are medical devices that should be handled properly; unfortunately in our study, observation of the population during the so-called "phase 2" has very often shown an inappropriate use of any type of mask which reduces its effectiveness. The correct dissemination of adequate information on how to use the mask and the strict control by the government not only on staying on the street wearing masks but above all on how they should be worn, could have further reduced the spread of Covid-19.

1. Introduction

In December 2019, new epidemic disease was reported in China, caused by a virus that belongs to the coronavidae called Covid-19. This novel disease is nowadays well known as SARS-CoV-2 capable to cause a severe acute respiratory syndrome which is easily spread among people thanks to its human-to-human transmissibility (Gorbalenya, 2020a, 2020b; Svoboda et al., 2004; Girard, 2003).

In the beginning, this disease represented a huge danger only for the entire China but very soon, because of the great amount of movement of people from China to other countries and vice versa SARS-CoV-2 have become a pandemic disease as declared from the World Health Organization (WHO) (Wilder-Smith, 2006; Aiello et al., 2010).

In an attempt to limit, as much as possible, the spread of this terrible disease, each nation has taken a number of government-run actions based on several factors (Wilder-Smith, 2020; Cetron and Landwirth, 2005; MacIntyre et al., 2010; Jefferson, 2008). This includes a physical separation between citizens who, for example, in Italy have been confined to their homes for a certain period with the possibility of going out only for mandatory reasons (Gumel et al., 2004; Rengasamy et al., 2004). After this period, a second phase emerged, during which it was possible to go out but following particular conditions such as the use of masks that would have limited the spread of Covid-19 through the micro-droplets emitted during breathing, coughing or phonation (Girard, 2003; Aiello et al., 2010; MacIntyre et al., 2010; Jefferson, 2008; Rengasamy et al., 2004; Leung et al., 2020; World Health Organization, 2009; Centers for Disease Control and Prevention, 2009; Bałazy et al., 2006; Chen et al., 1991; Grinshpun et al., 2009; Oberg and Brosseau, 2008).

The use of masks, which are medical devices, requires correct use, based on medical principles unfortunately not known by the whole population (Kirby, 2020; MacIntyre and Chughtai, 2015; Chen and Willeke, 1992; Myers et al., 1991). This cultural deficiency, linked to the breathing difficulties caused by the use of this filter, has led to incorrect management of these important medical devices, facilitating the commission of errors that can make the masks ineffective or even dangerous because they can become a vehicle for the spread of the disease itself (World Health Organization, 2009; Centers for Disease Control and Prevention, 2009; Bałazy et al., 2006; Chen et al., 1991; NIOSH, 1995; Tuomi, 1985; Weber et al., 1993; Wilder-Smith, 2020).

2. Material and method

In this study, conducted in Italy during the so-called phase 2, the behavior of the population outside their homes was observed, focusing on how the mask was worn and managed (Grinshpun et al., 2009; Oberg and Brosseau, 2008; Chen and Willeke, 1992; Myers et al., 1991; NIOSH, 1995; Tuomi, 1985; Weber et al., 1993; Cetron and Landwirth, 2005; Gumel et al., 2004; Svoboda et al., 2004; Wang et al., 2020; Desai and Mehrotra, 2020; Kirby, 2020; MacIntyre and Chughtai, 2015).

* Corresponding author at: Del Vespro, 129, 90127 Palermo, Italy.
E-mail address: alessandro.scardina@unipa.it (G.A. Scardina).

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Table 1
Type of mask.

Surgical Mask
Filtering mask with valve like FFP2/FFP3 type
Filtering mask without valve like FFP2/FFP3 type
Self-built mask or replaced by cloth

Table 2
Number of observations and types of masks.

Subjects observed in12 days (from 9 am to 8 pm): 1034
Subjects without any mask: 12
Subjects wearing mask (any type):1022
Subjects wearing surgical mask: 622
Subjects wearing FFP2/FFP3 mask (no valve): 118
Subjects wearing FFP2/FFP3 mask (with valve): 129
Subjects wearing diy mask or replaced by cloth: 153

All data were collected in a period of 12 days from 9 am to 8 pm; children and people with special needs were excluded as well as citizen observed while they were inside their cars.

The study was conducted on a sample of 1036 subjects observed in the street for 60 s each.

Most of the people observed were out of the shops waiting for their turn to enter and this facilitated the observation of the subjects who acted naturally not knowing they were being observed.

The parameters examined were the following: the type of mask (surgical mask, filtering mask with valve like FFP2/FFP3 type, filtering mask like FFP2/FFP3 type without valve, self-built mask or replaced by cloth), correctness in wearing it (covering nose and chin), and management (touching or not the mask on the external surface) (Desai and Mehrotra, 2020; Rengasamy et al., 2010; Leung et al., 2020; Wilder-Smith, 2006) (see Table 1). All collected data were statistically analyzed by chi square test.

3. Results

Out of a total of 1034 subjects observed, the following results were noted: 12 subjects were on the street without any mask, therefore the citizens who wore one were 1022; 622 people wore a surgical mask; 118 people wore a FFP2/FFP3 type filter mask without the valve, 129 people wore a FFP2/FFP3 type filter mask with valve, 153 people wore a clearly self-made mask with fabric or had fabrics such as scarves fitted in front of the mouth and/or nose. Only 264 showed an exemplary behavior by wearing the mask correctly, covering the nose and chin, and only 336 people during the entire period of observation (60 s) did not touch it (see Table 2).

4. Discussion

The data collected show important results that indicate how citizens' behavior may not be perfectly correct; the use of a medical device, such as a mask, which has an extremely important role in preventing the spread of infections in the air, must comply with very precise principles. The filtering mask must be worn and managed very carefully, otherwise it completely loses its effectiveness, even if the filtering power is particularly high as on those FFP2 and FFP3. Any type of mask must adhere perfectly to the nose and along its internal circumference, preventing air from passing sideways without any filtration (MacIntyre and Chughtai, 2020; Chughtai et al., 2013)≫(MacIntyre and Chughtai, 2020; Davies et al., 2013).

At the same time, the air emitted from the lungs should pass through the mask in order not to pollute the surrounding air.

Wearing a mask that does not adhere well to the face or even with the nose or mouth not covered properly, even makes the best device totally useless.

Table 3
Distribution of results (matrix).

Type of mask	Behavior			
	OK	NOSE NOT COVERED	CHIN NOT COVERED	NOSE & MOUTH NOT COVERED
Surgical mask: 622	194	224	135	69
FFP2/FFP3 type (no valve): 118	16	49	26	27
FFP2/FFP3 type (with valve): 129	37	46	33	13
Diy type: 153	17	97	18	21
Total: 1022	264	416	212	130

Table 4
Distribution of results (percentage matrix).

Type of mask	Behavior			
	OK	NOSE NOT COVERED	CHIN NOT COVERED	NOSE & MOUTH NOT COVERED
Surgical mask	31,18%	36,01%	21,70%	11,09%
FFP2/FFP3 type (no valve)	13,55%	41,52%	22,03%	22,88%
FFP2/FFP3 type (with valve)	28,68%	35,65%	25,58%	10,07%
Diy type	11,11%	63,39%	11,76%	13,72%

Data from this study showed that only 25.83% of subjects (264 out of 1022), observed for 60 s, had exemplary behavior.

Certainly the respiratory difficulty induced by the masks and the lack of the habit of wearing them regularly have contributed to this trend of the phenomenon.

Among the most noticed errors, regardless of the type of mask, the incorrectly covered nose was the most recorded, in fact 40.70% of the subjects belonging to the whole sample made this error. On the other hand, 20.74% of the total did not cover the chin well and 12.72% wore masks that left the nose and chin unsealed.

By analyzing all the results in detail, taking into account the type of mask, the following data were recorded:

Surgical masks were the most observed in our study (60.86%) probably because they are the cheapest and easiest to find at just a certain moment like this unexpected pandemic which created a much higher demand for these devices than normal production and market presence.

In addition, surgical masks are the lightest and therefore least annoying, especially for their lightness and the reduced impediment to the passage of inhaled and exhaled air.

Precisely because of their shape and manufacture, surgical masks seem to lend themselves very much to an incorrect way of wearing them with their noses exposed making them totally ineffective.

In fact, only 31.18% wore them correctly and 224 subjects (36.01%) out of a total of 622 committed this behavioral error; 21.70% of the subjects with surgical mask instead did not cover the chin letting the unfiltered air pass at this point; 11.09% did not adequately cover their nose or chin.

FFP2 / FFP3 masks without valve, i.e. those that require greater sacrifice both during inspiration and expiration, were noted on 118 subjects (11.54%) but only 13.55% of those who wore them he did it correctly; once again, the most common mistake was to leave the nose uncovered (41.52%) probably to resolve breathing difficulties.

FFP2 / FFP3 type masks with valve were noted on 129 subjects (12.62%), but only 28.68% of those who wore them did it correctly; 46 out of 129 subjects left the nose uncovered (35.65%) in any case less

than the same masks without valve probably because the valve makes breathing easier at least during the emission of air to the outside.

Do-it-yourself masks were the most imaginative and were found on 153 subjects (14.97%); they were mostly obtained from fabrics with questionable filtering power and in cases replaced by scarves or raised collars to more or less effectively cover the mouth and nose. Unfortunately, the nose in 63.39% was not covered making the intent, already in itself of doubtful functionality, certainly ineffective (Rengasamy et al., 2010; Chughtai et al., 2013; MacIntyre et al., 2015) (see Tables 3 and 4).

From the analysis of the data it follows that the government's effort to impose the use of a device particularly effective in preventing the spread of Covid-19 has influenced the lack of adequate medical knowledge by the population.

5. Conclusions

In retrospect, it is clear that in addition to the imposition of such important devices as masks, the education of the population and the diffusion of correct information by the government appears to be fundamental in order to reach even the most distracted citizens; once again it is clear that an enemy as subtle as Covid-19 can be defeated with intelligence and culture.

Correct diffusion of adequate information on how to use the mask and strict control by the government not only on staying in the street wearing the masks but above all on how they should be worn, could have further reduced the spread of Covid-19.

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