Impact on COVID-19 morbidity and mortality according to the regulations on the use of face mask

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Abstract

Introduction: Currently, the face mask represents an incomparable symbol whose value went from clinical work to impacting the containment of the spread of SARS-CoV-2, although it has become an element of discord in the general population.

Objective: To establish the impact of face mask use policies on COVID-19 morbidity and mortality. **Methods:** Face mask use policy variables, obtained from the website of the #Masks4All scientific movement, were associated with the number of infections, deaths and flattening of the curve published by the Johns Hopkins University resource center and EndCoronavirus.org.

Results: Face mask use policies were universal (required in shops, restaurants, public transport), partial (recommended, required in any public place) and absent. Associations of the face mask use policy with total cases ($p = 0.01$), cases per million ($p = 0.04$) and deaths per million population ($p = 0.02$) were statistically significant. Associations of the variables with the epidemiological curve trend were also statistically significant ($p = 0.00$). **Conclusion:** The recommendation for face mask widespread use is a measure with sufficient scientific support to reduce the number of COVID-19-related infections and deaths.

KEY WORDS: COVID-19. SARS-CoV-2. Face mask. Morbidity. Mortality.

Impacto en la morbimortalidad por COVID-19 según las regulaciones del uso de mascarilla

Resumen

Introducción: Actualmente, la mascarilla representa un símbolo incomparable cuyo valor pasó del trabajo clínico a impactar en la contención de la propagación del virus SARS-CoV-2; se convirtió en un elemento de discordia en la población general.

Objetivo: Establecer el impacto de las políticas de uso de mascarilla en la morbimortalidad por COVID-19. **Métodos:** Se asociaron las variables de política de uso de cubrebocas, obtenidas de la página web del movimiento científico #Masks4All, con el número de contagios, muertes y aplanamiento de la curva publicados por el centro de recursos de la Universidad Johns Hopkins y EndCoronavirus.org. **Resultados:** Las políticas de uso de mascarilla fueron de tipo universal (requerido en tiendas, restaurantes, transporte público), parcial (recomendado, requerido en cualquier lugar público) y ausente. Las asociaciones de la política de uso de mascarilla con casos totales ($p = 0.01$), casos por millón ($p = 0.04$) y muertes por millón de habitantes ($p = 0.02$) resultaron estadísticamente significativas. Las asociaciones de las variables con la tendencia de la curva epidemiológica también resultaron estadísticamente significativas ($p = 0.00$). **Conclusión:** La recomendación del uso generalizado de mascarilla es una medida con suficiente respaldo científico para reducir el número de contagios y muertes por COVID-19.

PALABRAS CLAVE: COVID-19. SARS-CoV-2. Mascarilla. Cubrebocas. Morbimortalidad.

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Introduction

Stanley Ipkiss ("The Mask"): "It's a power tie... It is supposed to make you feel powerful". This cinematographic dialogue perfectly suits the prominence of face masks during current pandemic, which have become a synonym of authority, a valuable possession.¹ The psychological symbolism of the mask is explained by the use of facial expressions to construct ideas about feelings and desires, and thus, the distortion caused by the mask favors an individual response that works in two forms: one that is controlled and another that is implicit.²

The use of face mask in the clinical field dates back to 1700, with the miasmatic theory, which popularized the famous "plague doctor" or beak-shaped masks, described by Charles de Lorme.¹ In one chapter of his operating theory, Martin Kirschner (1879-1942) referred to face masks as "measures to fight infections". In the 1920s, face masks were used for the first time in the surgical field in Germany and the United States.³

The use of protective equipment against respiratory infections within the clinical setting has no questioning regarding its usefulness.^{4,5} This has allowed this measure to be transferred to the general population, with a beneficial impact,⁵ which is why even face masks manufactured with rudimentary materials are considered a better alternative to an absence of protection.^{5,6} The most common face masks in the general population are made with surgical material with less filtration, as well as with daily use garments fabric,^{7,8} with filtration variations ranging from 9 to 98 %, which decreases with reuse and washing cycles.⁸

At the beginning of current pandemic, the general recommendation regarding the use of face masks was to ration them for use in the medical field, since it was considered that the evidence did not provide conclusive information for indicating widespread use;⁹ however, concerns of the scientific community generated a debate that led to the dissemination of multiple publications that supported its usefulness.^{10,11} After weighing the scientific data, the World Health Organization updated the standard for widespread use.¹² A systematic review and meta-analysis published by *The Lancet* in June 2020 was the final endorsement in favor of the indication.¹³ Despite the above, not all countries considered making this measure a mandatory element for their citizens.

The purpose of this study was to compare the impact of SARS-CoV-2 dispersion between countries with different face mask use policies.

Methods

A cross-sectional, descriptive, observational study was designed. The collected information was comprised of the figures of COVID-19 cases and deaths registered at Johns Hopkins University Coronavirus Resource Center official website (<https://coronavirus.jhu.edu/map.html>). The type of policy regarding the use of face masks was obtained from the #Mask4All movement official website (<https://masks4all.co>). A flattening the curve variable was added, with data obtained from the ENDCORONAVIRUS.org movement official website (<https://www.endcoronavirus.org/countries>). The date for data collection was August 30, 2020.

Statistical analysis was carried out according to Kolmogorov-Smirnov normality test; normal distribution was considered in case of a p-value > 0.05 (for applying Kruskal-Wallis test), non-normal distribution in case of p < 0.05 (for applying the Anova test), with a p-value < 0.05 being established as being statistically significant. For the relationship between the face mask use policy and the flattening of the curve, the chi-square test was applied. The SPSS program was used.

Results

Data from a total of 215 countries were collected; 129 countries had the corresponding information for the bivariate analyses. Face mask use policy categories were the following: universal, U (5.08 %); required in stores, restaurants, public transport, SRT (29.94 %); partial, P (11.30 %); recommended, R (8.47 %); required in any public place, PP (37.85 %) and absent, A (7.34 %). Epidemiological curve classification was indicated as follows: upward trend, UTc (62.41 %); downward trend, DTc (13.53 %); flattened, Fc (24.06 %). Worldwide, the number of total cases and deaths corresponded to 25,376,529 and 850,140, respectively; and total cases and deaths per million, to 3,256 and 109.1, respectively.

The countries with the highest number of total cases (Table 1) were the United States (6,172,082, P), Brazil (3,862,311, P), India (3,619,169, U), Russia (990,326, P), Peru (647,166, PP), South Africa (625,056, PP),

Table 1. The ten countries with the highest number of cases by August 30, 2020

Country	Total cases	Cases/1,000,000 population	Total deaths	Deaths/1,000,000 population	Face mask use policy
United States	6,172,082	18,629	187,215	565	P
Brazil	3,862,311	18,149	120,896	568	P
India	3,619,169	2,618	64,617	47	U
Russia	990,326	6,786	17,093	117	P
Peru	647,166	19,584	28,788	871	PP
South Africa	625,056	10,518	14,028	236	PP
Colombia	607,938	11,927	19,364	380	SRT
Mexico	591,712	4,582	63,819	494	SRT
Spain	455,621	9,744	29,011	620	SRT
Chile	409,974	21,417	11,244	587	SRT

U = universal, SRT = required in shops, restaurants, public transport; P = partial, PP = required in any public place.

Colombia (607,938, SRT), Mexico (591,712, SRT), Spain (455,621, SRT) and Chile (409,974, SRT).

The highest number of total deaths was observed in the United States (187,215, P), Brazil (120,896, P), India (64,617, U), Mexico (63,819, SRT), United Kingdom (41,499, SRT), Italy (35,477, SRT), France (30,606, SRT), Spain (29,011, SRT), Peru (28,788, PP) and Iran (21,462, PP).

The countries with most cases per million population were Qatar (42,230, PP), Bahrain (30,153, SRT), Chile (21,417, SRT), Panama (21,284, PP), San Marino (20,917, A), Kuwait (19,772, SRT), Peru (19,584, LP), Aruba (18,692, no data on policy), United States (18,629, P), Brazil (18,149, P) and Oman (16,686, PP).

The highest number of deaths per million population was recorded in San Marino (1,237, A), Belgium (853, SRT), Peru (871, PP), Andorra (686, PP), Spain (620, SRT), United Kingdom (611, SRT), Italy (587, SRT), Chile (587, SRT), Sweden (576, no data on policy), Brazil (568, P) and the United States (565, P).

The countries with flattening of the curve were Malaysia (U), Haiti (PP), Djibouti (PP), Thailand (PP), Somalia (A), Sri Lanka (PP), Mali (PP), Estonia (R), New Zealand (A), Uruguay (SRT), Cyprus (P), Georgia (SRT), Latvia (SRT), Burkina Faso (PP), Nigeria (no data on policy), Andorra (PP), Vietnam (PP), San Marino (A), Taiwan (SRT), Mauritius (PP), Mongolia (PP), Cambodia (P), Bhutan (R), Barbados (SRT), Brunei (P), Monaco (SRT), Liechtenstein (R), Fiji (no data on policy), Timor-Leste (SRT), Dominica (PP), Saint Kitts and Nevis (PP) and Vatican City (P).

Figures 1 to 4 illustrate the differences in the countries according to their policies on the use of face mask.

In the relationship of the mask use policy with the flattening of the curve, no statistically significant association was found ($p = 14,718$). Quantitative variables distribution had a p-value of 0.00, with Kruskal-Wallis test being therefore applied. Face mask use policy associations with total cases ($p = 0.01$), cases per million ($p = 0.04$) and deaths per million population ($p = 0.02$) were statistically significant, but not with the number of total deaths ($p = 0.222$) (Table 2). The same variables had a statistically significant association ($p = 0.00$) with the epidemiological curve trend.

Discussion

Considering the indisputable relationship between the use of face masks and a lower number of contagions, in the analyzed sample we observed that 15.81 % of the countries worldwide did not have any established policy for the use of face mask (recommended or absent), and that among the 10 leading countries with more cases, none had a policy in that regard, although the conviction to adopt the use of face mask has increased over time.¹⁴

Of note, a low global percentage of countries have a universal policy (5.08 %), and a geographical majority have intermediate indications (almost 80 %). The case of India stands out, since it appears in all lists of high figures despite the policy of face mask

Figure 1. Differences between face mask use policies and total cases. U = universal, SRT = required in shops, restaurants, public transport; P = partial, R = recommended, PP = required in any public place, A = absent.

Figure 2. Differences between face mask use policies and cases/1,000,000 population. U = universal, SRT = required in shops, restaurants, public transport, P = partial, R = recommended, PP = required in any public place, A = absent.

universal use. However, late implementation of this measure can facilitate an accelerated initial number of contagions. In a scenario of a much higher exposure, given the number of patients with transmission potential, there is a higher viral load at each affected area. A work recently published in *The New England Journal of Medicine* suggests that if viral load is important for the severity of SARS-CoV-2 infection to

be determined, a hypothetical reason for using face masks would be the reduction of the inoculum the user is exposed to and the subsequent clinical impact on the disease.¹⁵

The misinformation factor should also be taken into account.^{16,17} There are countries where, despite having a considerable dissemination of scientifically supported data, a good number of their inhabitants refuse to

Figure 3. Differences between face mask use policies and total deaths. U = universal, SRT = required in shops, restaurants, public transport, P = partial, R = recommended, PP = required in any public place, A = absent.

Figure 4. Differences between face mask use policies and deaths per million population. U = universal, SRT = required in shops, restaurants, public transport, P = partial, R = recommended, PP = required in any public place, A = absent.

wear face masks, either due to conspiracy theories, claims of individual liberties or other particular ideas that are characteristic of psychological responses to crises.^{18,19} Cases such as the protests that took place in the United States or Germany^{20,21} are the most notorious examples, although it is a fact that Mexico is also under the influence of this type of phenomena,

with consequences such as violence against health-care workers.²²

On the other hand, social distancing is regarded as the central axis of transmission reduction.¹³ Complementary measures such as hand washing, eye protection, disinfection of environmental surfaces, self-care in case of suspicious symptoms are part of

Table 2. Number of cases and deaths in 129 countries by August 30, 2020, according to face mask use policy

Policy	Total cases	Total cases/1,000,000 population	Total deaths	Total deaths/1,000,000 population
U	427,951.5	1,809.0	8,466.7	60.8
SRT	91,612.1	5,022.7	5,586.8	161.5
P	567,213.9	3,571.6	18,816.0	96.7
R	7,728.8	2,094.4	451	89.1
PP	66,210.7	4,018.6	1,926.2	80.0
A	11,342.7	3,483.5	307.6	143.5
p-value	0.01	0.04	0.22	0.02

U = universal, SRT = required in shops, restaurants, public transport; P = partial, R = recommended, PP = required in any public place, A = absent. p-value < 0.05 was statistically significant.

the multiple recommendations where there is some level of evidence for their dissemination.^{13,23}

An additional issue is face masks reuse. Application of a universal mandatory policy does not necessarily take into account the resources required for its accomplishment and, even less, the possibility of renewal, in addition to the fact that the measure also has a basic quality requirement.⁸ The phenomenon of disparity can even be considered for the differences in knowledge, attitude and self-care practices during the pandemic to be understood.²⁴

Let us also consider that the provided statistics illustrate the number of cases that are confirmed through tests that have been standardized for this purpose, and that the estimations that are postulated for underreporting to be corrected could therefore indicate a different pattern;^{25,26} these numbers depend on the quantity and quality of tests carried out by each country (e.g., the sensitivity of polymerase chain reaction [PCR] is almost 100 %, but its specificity varies from 60 to 89 %²⁷), on the handling itself of the data contained in the registries, and even on the way transmission of the virus regionally behaves.

Despite the above, it is a statistical fact that, in our research, we found a significant relationship between the policy on face mask use and the number of contagions, which supports previous findings.^{13,23,28} The analysis carried out so far is useful in the absence of a statistically significant link between the face mask use policy and the flattening of the curve phenomenon.

The statistically significant relationship between mortality/case fatality rate (in deaths per million population) and the use of face masks, adds evidence to publications that support this impact.²⁸ Initially, age was considered to be the differential factor in

mortality;²⁹ however, evolution of the pandemic has conferred weight to comorbidities not only in terms of the risk of death, but also regarding the severity of the condition and the probability of admission to a critical care unit.³⁰ Obesity, hypertension and diabetes are the main risk factors,^{23,31} as well as illnesses that most countries with a high mortality rate are quite familiar with due to their elevated prevalence. Sociodemographic, geographic and environmental characteristics, as well as those diseases that are characteristic of each region, are going to be a determining element for these estimations.²³ Although the policy on the use of face masks will not have all the weight in this impact, the fact that reducing the speed of transmission can optimize available resources for patient care cannot be overlooked; that was the lesson learned from the spread of COVID-19 through Asia and Europe.^{32,33} Finally, it should be borne in mind that, so far, there is no specific treatment for this disease, a fact that makes it essential for a model focused on prevention to be proposed.³⁴

Conclusions

The recommendation for the widespread use of face mask is a measure with sufficient scientific support for reducing the number and speed of SARS-CoV-2 infection transmission and mortality, which is why it is necessary for it to be considered when establishing containment measures for critical episodes similar to that of current pandemic. The value of a generalized policy is considerably high in the scenario of new outbreaks, with the need for citizen education. There are multiple additional variables that must be considered, which are more complex when the mortality/case fatality rate aspect is examined.

Our limitations in the analysis were the scarcity of data and the fact that the sources were not the official ones of each country (although they were linked to academic entities), as well as information dynamic behavior.

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Conflict of interests

The authors declare that there are no conflicts of interest.

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Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this research.

Confidentiality of data. The authors declare that no patient data appear in this article.

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