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Letter to the Editor

Mass masking as a way to contain COVID-19 and exit lockdown in low- and middle-income countries

We read with interest the research work of Cheng and collaborators on community-wide mask use for Coronavirus Disease 2019 (COVID-19) control. Indeed, face masks are now recommended by the World Health Organization (WHO) to prevent COVID-19 transmission, according to new guidelines published on June 5th 2020. The new recommendations state that in areas with ongoing COVID-19 community transmission, governments should encourage the general public to wear masks in specific situations and settings where physical distancing cannot be achieved, as part of a comprehensive approach to suppress COVID-19 transmission. Long before the issuance of these guidelines, many Asian countries were already using face masks and this potentially contributed to the rapid containment of COVID-19 in these countries. Outside of Asia, routine use of masks by the general population is rare. Most European countries were applying previous WHO recommendations whereby face masks were reserved for COVID-19 patients, carers or healthcare workers. Moreover, there were fears that promoting mass masking could aggravate the shortage of face masks among healthcare workers, especially as cloth (fabric) masks were not initially considered useful for COVID-19 prevention in Europe. The Director-General of the Chinese Center for Disease Control and Prevention went as far as warning Europe and the United States of America (USA) regarding the risks of not enforcing routine wearing of face masks by the general public. Most low- and middle-income countries (LMIC) outside of Asia also initially deprioritised masks and focused on lockdown strategies in an attempt to “flatten the curve”. However, lockdowns are associated with major socio-economic losses which may further exacerbate the precarious conditions in resource-limited settings, and thus compliance to such strategies is implausible (particularly among populations who depend on daily labor for their income). Furthermore, in highly congested settings such as urban slums or refugee camp settings, lockdowns and/or measures of physical distancing are not feasible. The benefits of isolation-based strategies are also limited, given that pre- and asymptomatic individuals are potentially contagious for COVID-19.

We thus welcome the WHO recommendations to use face masks in the general population, as an important component of strategies to stop the epidemic and/or exit the lockdowns, particularly in LMIC. Recent evidence supports a predominantly airborne transmission route for COVID-19, and strongly encourages face mask use in public to prevent inter-human transmission. Modelling studies estimate that the COVID-19 pandemic can be brought to an end if 80% of the population would wear a surgical mask. Moreover, mass masking could also alleviate fears that prevent people from seeking medical care for non-COVID-19 conditions, limiting the collateral damage of the COVID-19 pandemic.

On the downside, improper mask use may inadvertently increase COVID-19 transmission via indirect contact routes with the mask serving as a fomite. Mass making may also produce a false sense of security leading to reduced adherence to other preventive measures such as hand hygiene. Finally, surgical masks pose an environmental threat if discarded inappropriately due to their plastic content. It is therefore paramount to monitor both compliance and user practices in ensuring the effectiveness of masks in COVID-19 control.

Between March and June 2020, an international consortium (www.IFCovid.com) organised online surveys in LMIC to monitor adherence to COVID-19 preventive measures, including face mask use. Only data of consenting respondents who were at least 18 years old and who self-identified as either male or female were analysed (n = 206,729). Adherence to face mask use ranged from 32.7% to 99.7% in the surveyed countries during the ongoing pandemic (Table 1). In countries where mask was mandatory or highly encouraged by the government during the early phases of the COVID-19 outbreak, adherence rates were > 90%. In Brazil, the initial low adherence to face mask use together in combination with little or no confinement measures may have contributed to the high COVID-19 mortality in this country. Where data were available on the type of mask used, reusable cloth masks (more cost-beneficial and environmentally friendly than surgical masks) were the most frequent accounting for 4413/8636 (51.1%) of all mask types. Our study shows that even in countries where no pre-existing culture of mask use existed, high uptake of mass masking was feasible. The differential rate of uptake between sexes and age groups, as shown in Table 2, suggests that targeted health promotion strategies to (further) stimulate mask use may need to be developed, and that COVID-19 prevention strategies need to be contextualized to each setting/population.

A few points are worth noting when interpreting our findings: As this was an online survey, respondents were more likely to be young adults with a higher level of education; hence the results are not generalizable to the national population. Also, the cross-sectional nature of our surveys may not capture the rapid evolution of preventive measures and behavior during this COVID-19 pandemic; indeed, the different time points of our surveys may influence the findings on mask use. For instance in Brazil during a second (n = 4650) and third survey (n = 1890), face mask use increased to 89.7% and 96.9% respectively following the government’s progressive implication in ensuring mask wearing in public.

Many unknowns persist regarding the effectiveness of mass masking to prevent infection with respiratory viruses, including COVID-19. Results from cluster randomized controlled trials on the use of masks among young adults living in university residences in the USA indicated that face masks may reduce the rate of influenza-like illness, but showed no impact on the risk
Table 1
Survey characteristics and overall adherence to mask use for COVID-19 prevention.

| Country               | Period of the survey          | Number of respondents | Median age in years (IQR) | Participants with a university degree: n/N (%) | Participants who reported using face mask: n/N (%) | Face mask use mandatory at the time of survey | Number of COVID-19 cases (and deaths) |
|-----------------------|-------------------------------|-----------------------|---------------------------|-----------------------------------------------|--------------------------------------------------|------------------------------------------|-------------------------------------|
| Brazil                | April 3rd to 9th              | 25,103                | 48.0 (37.0 – 58.0)        | 22,383/25,103 (89.2%)                         | 11,480/25,103 (45.7%)                             | No                                       | 1313,667 (57,070)                   |
| Democratic Republic of Congo | April 23rd to June 8th      | 3380                  | 34.0 (27.0 – 44.0)        | 1491/3380 (44.1%)                             | 1404/3252 (43.2%)                                 | Yes                                      | 6826 (157)                          |
| Ecuador               | April 1st to 7th              | 1632                  | 24.0 (21.0 – 37.0)        | 1322/1632 (81.0%)                             | 1496/1632 (91.7%)                                 | No                                      | 55,255 (4429)                       |
| Mozambique            | May 11th to 17th              | 3770                  | 33.0 (27.0 – 40.0)        | 2596/3770 (68.9%)                             | 3541/3770 (93.9%)                                 | Yes                                      | 859 (5)                             |
| Peru                  | June 5th to 11th              | 3264                  | 41.0 (29.0 – 53.0)        | 3068/3264 (94.0%)                             | 2988/2997 (99.7%)                                 | Yes                                      | 275,989 (9135)                      |
| Somalia               | April 21st to May 7th         | 4116                  | 22.0 (20.0 – 24.0)        | 3812/4116 (92.6%)                             | 2107/4116 (51.2%)                                 | No                                       | 2878 (90)                           |
| Thailand              | March 24th to 25th            | 161,580               | 43.0 (34.0 – 52.0)        | NA                                            | 151,834/161,580 (94.0%)                           | Yes                                      | 3162 (58)                           |
| Uganda                | April 16th to 30th            | 1713                  | 34.0 (28.0 – 42.0)        | 1655/1713 (96.6%)                             | 561/1713 (32.7%)                                  | No                                       | 833 (0)                             |
| Vietnam               | March 31st to April 6th       | 2171                  | 28.0 (23.0 – 37.0)        | 1676/2171 (77.2%)                             | 2158/2171 (99.4%)                                 | Yes                                      | 355 (0)                             |

NA: Not available.

* Missing data on face mask use.

b Mandatory face mask use was initially implemented only in Kinshasa (as from April 20th), and in other parts of the country during the month of May.

c Face mask use was highly encouraged, but only became mandatory as from April 8th.

d National statistics as of the 29th June 2020 (Available at: https://covid19.who.int/).
Table 2

Age- and sex-stratified face mask use by participants.

| Continent | Country           | Face mask use by age groups: n/N (%) | P-value<sup>a</sup> | Face mask use by sex: n/N (%) | P-value<sup>a</sup> |
|-----------|-------------------|--------------------------------------|---------------------|-------------------------------|---------------------|
|           |                   | 18–25 | 26–40 | 41–60 | > 60 |             | Male | Female |             |           |
| South America | Brazil          | 422/1720 (24.5%) | 2227/6618 (33.7%) | 5561/11,743 (47.4%) | 3270/5022 (65.1%) | < 0.001 | 2701/7097 (38.1%) | 8779/18,006 (48.8%) | < 0.001 |
|           | Ecuador          | 842/935 (90.1%) | 336/369 (91.1%) | 288/295 (97.6%) | 30/33 (90.9%) | < 0.001 | 578/642 (90.0%) | 918/990 (92.7%) | 0.054 |
|           | Peru<sup>b</sup> | 424/425 (99.8%) | 1067/1073 (99.4%) | 1184/1185 (99.9%) | 313/314 (99.7%) | 0.229 | 1086/1090 (99.6%) | 1902/1907 (99.7%) | 0.614 |
| Asia      | Thailand         | 13,511/14,413 (93.7%) | 51,958/55,295 (94.0%) | 75,059/79,834 (94.0%) | 11,305/12,038 (93.9%) | 0.629 | 42,177/44,828 (94.1%) | 109,657/116,752 (93.9%) | 0.217 |
|           | Vietnam          | 840/846 (99.3%) | 910/910 (100%) | 387/391 (99.0%) | 21/24 (87.5%) | < 0.001 | 715/721 (99.2%) | 1443/1450 (99.5%) | 0.320 |
| Africa    | Democratic Republic of Congo<sup>b</sup> | 256/667 (38.4%) | 742/1541 (48.2%) | 347/915 (37.3%) | 59/129 (45.7%) | < 0.001 | 696/1128 (61.7%) | 708/2124 (33.3%) | < 0.001 |
|           | Mozambique       | 696/760 (91.6%) | 1975/2094 (94.3%) | 780/820 (95.1%) | 90/96 (93.8%) | 0.019 | 2017/2174 (92.8%) | 1524/1596 (95.5%) | < 0.001 |
|           | Somalia          | 1781/3474 (51.3%) | 297/589 (50.4%) | 26/46 (56.5%) | 3/7 (42.9%) | 0.834 | 102/2490 (41.0%) | 1085/1626 (66.7%) | < 0.001 |
|           | Uganda           | 94/257 (35.8%) | 303/964 (31.4%) | 148/451 (32.8%) | 18/41 (43.9%) | 0.245 | 293/1006 (29.1%) | 268/707 (37.9%) | < 0.001 |

<sup>a</sup> Chi Squared test.

<sup>b</sup> Missing data on mask use.
of laboratory-confirmed influenza. A recently published meta-analysis demonstrated that either disposable surgical masks or reusable 12–16-layer cotton masks were associated with protection of healthy individuals within households and among contacts of cases. So far, no trial has documented the added value of mass masking for COVID-19 prevention in a community-based setting, although this is suggested by observational reports.

As there is currently no effective vaccine or treatment against COVID-19, the mass masking policy of the WHO is a prudent move for COVID-19 prevention. We therefore urge the public health and scientific communities to invest in strategies to promote mask use among all tiers of the population, and to further build the evidence-base for optimal COVID-19 prevention strategies.

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References

1. Cheng VC-C, Wong S-C, Chuang VW-M, So SY-C, Chen JH-K, Sridhar S, et al. The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2. J Infect 2020;81(1):107–14.
2. World Health Organization. Advice on the use of masks in the context of COVID-19: interim guidance, 5 June 2020. Geneva: Available from: https://apps.who.intiris/handle/10665/332293.
3. Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. Lancet Resp Med 2020;8(5):434–6.
4. Cohen J. No wearing masks to protect against coronavirus is a ‘big mistake,’ top Chinese scientist says. Science 2020 Mar 27 Available from: https://www.sciencemag.org/news/2020/03/not-wearing-masks-protect-against-coronavirus-big-mistake-top-chinese-scientist-says. doi:10.1126/science.abb5368.
5. He X, Lau EHY, Wu P, Deng X, Wang J, Hao X, et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med 2020;26(5):672–5.
6. Zhang R, Li Y, Zhang AL, Wang Y, Molina MJ. Identifying airborne transmission as the dominant route for the spread of COVID-19. Proc Natl Acad Sci USA 2020 Jun 11;202009637.
7. Ngonghala CN, Iboi E, Eikenberry S, Scotch M, Machtyre CR, Bonds MH, et al. Mathematical assessment of the impact of non-pharmaceutical interventions on curtailing the 2019 novel Coronavirus. Math Biosci 2020;325:108364.
8. Shetty SS, Wollenberg B, Merchant Y, Shahabi N, Discarded Covid 19 gear: a looming threat. Oral Oncol 2020;104868.
9. Aiello AE, Perez V, Coulibom RM, Davis BM, Uddin M, Monto AS,Yang Y, editor Facemasks, Hand Hygiene, and Influenza among Young Adults: a Randomized Intervention Trial. PLoS ONE 2012;7(1):e9744.
10. Chu DK, Akl EA, Duda S, Solo K, Yaacob S, Schunemann HJ, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet 2020 5014067362031142.
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