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Review Article

The problem with communication stress from face masks

Daniel M. Campagne

Universidad Nacional de Educacion a Distancia, Madrid, Spain

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ABSTRACT

Objective: Widely present pandemic-related stress resulting from the use of face masks needs definition, evaluation and treatment. Mouth coverings hamper communication, increasing stress that possibly compromises the immune system and psychological well-being of patients, health professionals and general population. Most present mouth coverings have limited antiviral efficacy but possess social and political value in addition to positive and negative psychological implications. Transparent filtering materials have become available and may help reduce communication stress, alongside several cognitive approaches.

Method: A systematic search was performed of the period 2000–2020 using the keywords, with no language limits, of databases including MEDLINE/PubMed, Science Direct, PsycInfo, Google Scholar and Cochrane. The search produced 247 articles, of which 84 were partly relevant.

Conclusion: Communication stress showed to be relevant in all clinical situations and in the general population. Currently no specific solutions for face mask-related communication stress are available, save for an increased use of body language and stress management. Transparent face coverings could be a panacea. Treatment of pandemic-related stress should have specific itemized protocols.

1. The social legitimacy of pandemic face mask use

Different types of face coverings suit different purposes and situations. Medical or surgical masks and homemade mouth coverings predominantly protect others (the public) but much less so the wearer, whilst a respirator may offer some protection to both wearer and others, provided it seals against the skin and is combined with goggles.

European Union (Filtering Face Piece or FFP; P) and North American (N) standards establish minimum filtering percentages for general use: FFP2 & P2 at least 94%; and N95 at least 95%. As a medical device, the filtering capacity of masks should be over 95%, preferably 97% and optimally 99%. Theoretically, an FFP2 or higher respirator will partly retain virus-size particles (0.3 particle microns (PM) (Zhu et al., 2020). Face masks are presently being given a different use from what the 2007 and 2014 World Health Organization (WHO) Guidelines for the Prevention of Infection describe as their intended use (WHO, 2014). The 2014 guidelines only distinguished Medical Masks (for facial protection against splashes of fluids), and Particulate Respirators (filters that seal against the face). At present, the WHO includes other, even homemade coverings, implicitly accepting filter efficacies of (far) below 85% (WHO 2020a). In any case however, filter efficacy decreases rapidly with use or inadequate disinfection. Nevertheless, inefficient coverings remain equally relevant for stress. The review by Macintyre and Chughtai (2020) reflects that in many studies, and not only in pandemic settings, surgical masks did not significantly protect against viral, bacterial, droplet or other infections. Targeted use of a respirator protected against bacterial and droplet infections, but not against viral infections and, as demonstrated in several studies and now generally recognized, viral infections in healthcare settings can be airborne. It is true that mask use by apparently healthy (non-symptomatic) people could help reduce pre-symptomatic infection and serve as an added means of source control of these non-symptomatic, but nevertheless infected persons. This could justify obligatory face mask use. However, health care workers and those in contact with infected persons need to use respirators, goggles and protective clothing continuously when in the presence of possible infection. Even with complete personal protective equipment (PPE), health care workers were found to readily become infected.

The COVID-19 pandemic has shown to cause a number of clinically relevant stress situations for the infected and their social networks, health care and public safety workers, authorities and, most importantly in terms of number, the general public. Stress affects immune system efficacy and reduces psychological resistance to pandemic situations (Leonard, 2017; Mattos Dos Santos, 2020). COVID-19-related stress results from several primary health-related causes but also has secondary psychologically relevant origins such as (feared) loss of work, reduced liberty of movement and precarious food supply, as has been established in large samples. Having to wear and to communicate wearing a face mask, and with a person wearing a mask have become important causes

E-mail address: dmcampagne@gmail.com

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of stress, as we shall review. An aggravating factor is the questioned legitimacy and efficacy of obligatory face mask use.

Pandemic suffering leads to distress, anxiety and other psychological problems (Luo et al., 2020; Xiong et al., 2020). Specifically, communication stress originates when interpersonal communication is negatively affected, as with face coverings. One result is a markedly reduced patient-doctor relational continuity (Wong et al., 2013). Another is the "McGurk" effect, when visual and auditory information do not coincide and the brain interprets wrongly (Magnotti and Beauchamp, 2017). Face masks are an under-researched cause of communication stress in vulnerable cohorts in pandemic situations. Vision of the mouth remains important for sign language users and non-transparent face masks add to their inaccessibility. Face mask (Nobrega et al., 2020) obligatory use is controversial and their general efficacy is debated, especially as the term 'mask' is now used for any face covering, whatever its effectiveness. Health specialists' statements on mask use have been misinterpreted and at times are contradictory. The Institute for Health Metrics and Evaluation (IHME) at the University of Washington recently considered that mask use can reduce transmission of the virus by up to 30%, which by some was considered sufficient justification for obligatory use. However, the study analysis combined data on respirators and surgical masks, making its conclusions valid only for health workers but not for the general public (IHME, 2020). In June 2020, the World Health Organization (WHO) also published a meta-analysis in ambivalent terms on the topic of masks (Chu et al., 2020). The British Parliamentary Office of Science and Technology (POST) was quick to point out: "A review of multiple studies published in The Lancet concluded that there is role for masks and eye protection in reducing exposure to COVID-19, but notes that the certainty about the evidence is low (…). Most studies in this review were about other coronaviruses and none of the COVID-19 studies included were conducted in community settings" (POST, 2020). Clearly, surgical masks protect the wearer less than they protect others: they produce less outward transmission. This is in essence what IHME and WHO also affirm, as do other recent studies (Marasinghe, 2020; Dugré et al., 2020). Greenhalgh et al. defend that policy makers should apply the "precautionary principle" and encourage people to wear face masks on the grounds that "we have little to lose and potentially something to gain from this measure" (Greenhalgh et al., 2020). This seems poor justification for such a far-reaching social measure with uncontrolled negative implications. An obligation to wear masks without solid evidence as to their efficacy is creating social rejection and reduces peoples' motivation to collaborate in prevention in general. People may not only come to reject masks, but also may reject rules and recommendations as to distancing, natural ventilation, tracking and voluntary isolation and, in general, become belligerent and set against any imposed COVID-19 health measures. People generally appear more motivated to protect themselves than to protect others, thus authorities must take care to maintain the "illusion-in-part" that masks also protect against becoming infected. Whatever efficacy has presently been found for most mask materials heavily depends on use- and user-dependent factors, such as cost and availability, hygiene and force of speech. For a computer model of the inhalation infection risk and various mask materials see Wilson et al. (2020). The lead author commented: "Proper use of masks is so important. Also, we were focusing on masks protecting the wearer, but they're most important to protect others around you if you're infected" (Wilson, 2020). Consequently, psychological approach and public information should insist that common surgical or homemade masks do offer limited protection to others but much less to a healthy wearer. What protection there is will be considerably reduced when the mask

- is being incorrectly worn (loosely or not covering the nose)
- has been in use for more than 4 hours
- is used by a person speaking loudly
- was manipulated or touched with possibly contaminated hands
- was stored inadequately between limited periods of use
- has suffered inadequate disinfection or decontamination
- is not certified for sanitary use
- does not retain PM 0.1 particles in dry warm conditions (Zhao et al., 2020)

Incorrect use or "negative use" has been shown to produce stress, anxiety, aggressive behavior and violence. Legal changes were needed, such as SB0471 in Illinois (August 7, 2020), which now classifies violence in opposing face mask policies as a felony, with up to five years in prison and fines up to $25.000 (WebMD, August 13, 2020).

2. The mask/stress relationship

Pandemic-related stress and face masks interact for two main reasons:

1) There is no consensus as to why, under what circumstances, and what type of face masks should be worn. The implicit controversy creates uncertainty, and thus creates stress.
2) Covering the face with a mask significantly adds to situation and communication stress.

The aforementioned WHO guidelines concern droplet-transmitted pathogens but not aerosolized pathogens. Droplets and other particles do not travel in a straight line from a speaker's mouth to the face of the person spoken to. They are partly aerosolized and carried in whichever direction the air moves (Balachander et al., 2020). A mask or respirator's filter mesh has been shown to only partially retain aerosolized droplets. The WHO recently and belatedly recognized a possible real transmission risk by means of these very small airborne viral particles, in view of growing evidence as to their longer-lasting effects in the air indoors over distances beyond those recommended for social distancing (New York Times, 2020). Since then further research has confirmed this means of viral propagation (Tang et al., 2020), creating an increased sense of insecurity or threat in many people.

As to their role in pandemic-related stress, the limited filtering efficacy of common face masks produces stress that may be partly counterbalanced by their social, psychological and legal advantages. We already identified a markedly reduced patient-doctor relational continuity and the McGurk effect. Other identified sources of mask stress include having to communicate with covered mouths, and perceiving the mask as a stigma of a potentially severe, contagious and life-threatening medical condition. Another stigma may follow from personal and social gender and religious concepts as to the propriety for a man or a woman to wear a mask (Willingham, 2020). Men are less inclined to wear masks, and this toxic masculinity attitude increases the stress experienced by women they work with, or live with. The male reluctant attitude towards mask use causes more men to die from COVID (Galasso et al., 2020; Capraro & Barcelo (preprint), 2020).

In 2016, well before COVID-19, a meta-analysis found important gender differences in health-protective behaviors in respiratory viral diseases and pandemics. It found a global relationship between gender and health-protective behavioral response. Women were found more (50%) likely to adopt/practice non-pharmaceutical protective behaviors such as face mask use, while men adopt/practice somewhat more (12%) pharmaceutical ones (Moran and Del Valle, 2016).These gender-related differences accentuate communication stress in pandemic health situations. We make a further distinction: when considering stress produced by a sanitary implement such as a face mask, 'normal' or habitual stress is to be differentiated from 'special' or circumstantial stress. The first will always be present under the same or similar health-related conditions. In the operating room, medical professionals will have higher stress levels than in the preparatory briefing. A firefighter will be significantly more stressed when attending an emergency than when writing the report afterwards. Normal or habitual stress correlates inversely with (professional) habituation or training. As Johnson (2016) concludes: "Training is important to improve the wearer's (of a mask or respirator) ability to

respond to work conditions, but does not eliminate the basic physiological and psychological limits to performance". Habitual stress is produced within those 'limits' and any contraption covering the mouth may contribute to habitual stress. But one thing is to wear a face mask as part of habitual working attire under normal work conditions, when inconveniences and the stress they produce are accepted, and quite another situation develops when the workplace is overcrowded, understaffed and short of supplies and extreme efforts with uncertain results are required. That is when 'special' circumstantial stress quickly develops as a signal of possible overload. In hospitals or clinics, wearing a mouth covering impairs communication through hampered speech, causes slower mutual understanding of patients or colleagues and overheating and moistening of the mask due to heavier breathing (Bandaru et al., 2020; Ribeiro et al., 2020). However, this may still qualify as secondary habitual stress within acceptable parameters until emergency or overload situations develop, as in pandemics. The same is true of patients' experience. Obligatory public use of masks produces a different field of stress experience, where the credibility of any presupposed efficacy or justification is essential.

As referred earlier, governments and health authorities have been defending that benefits of masks outweigh negative effects, such as the stress they produce. On August 20, 2020, the U.S. Food and Drug Administration (FDA) confirmed that surgical masks have limited efficacy: "While a surgical mask may be effective in blocking splashes and large-particle droplets, a face mask, by design, does not filter or block very small particles in the air that may be transmitted by coughs, sneezes, or certain medical procedures. Surgical masks also do not provide complete protection from germs and other contaminants because of the loose fit between the surface of the mask and your face." (FDA, 2020).

In a similar sense, the Australian government's Infection Control Expert Group (ICEG) published a document in July 2020 addressing the uncertain benefits from masks (ICEG, 2020). Point 4 says: Face masks are most likely to be effective when worn by infected persons (source control) to protect others. They may be less effective in protecting uninfected people exposed to a COVID-19-infected person not wearing a mask (…). Point 5 adds another reserve: The effectiveness of face masks depends on consistent and correct use, including covering the nose and mouth adequately.

Each person will weigh this limited protection against other consequences of the obligatory use of face masks, such as the stress they may cause in the wearer and others. Stress is a cause and consequence of loneliness, eminently relevant in pandemic situations and especially for those who 'catastrophize' the pandemic (Rogers et al., 2020; Holman et al., 2020). Negationist attitudes or denial of the pandemic's danger also increase stress, as a consequence of their continuous conflict with society's mainstream attitudes.

3. Positive and negative psychological mask effects

It may be not clear enough that the terms 'face mask', 'surgical mask', 'medical mask' and 'respirator' do not define technically identical face-coverings (IHME, 2020; POST, 2020). However, for perceived stress all classes of mouth coverings are of influence, and the personal reasons for wearing a mask are psychologically relevant. Face coverings have become symbols.

The WHO has stated that "The use of a mask alone is insufficient to provide an adequate level of protection or source control, and other personal and community level measures should also be adopted to suppress transmission of respiratory viruses", However, here it is referring to transmission, not to being infected (WHO, 2020c). The study concludes that "the findings of this systematic review and meta-analysis support physical distancing of 1 m or more and provide quantitative estimates for models and contact tracing to inform policy. Optimum use of face masks, respirators, and eye protection in public and health-care settings should be informed by these findings and contextual factors." Masks are psychologically relevant because their use has become a matter of public order, fear and doubts.

Studies confirm the extent to which the wearer's speaking habits are of influence, with exhaled particles increasing tenfold from the quietest to loudest vocalizations, irrespective of language, temperature and humidity (Asadi et al., 2019). This implies that rules of safe distancing should depend on speaking habits. However, this leads to a vicious cycle: whenever mask use hampers communication and provokes stress, the normal reaction of "speaking up" will produce more particles and, to counteract this effect, a greater distance should be observed, which will then annul the expected benefit of speaking up, thus communication stress ensues.

The social function of face masks and respirators seems to be an example of a value given to probably inadequate measures. Presently, any face covering is considered sufficient to comply with legislation on protective measures but, importantly, they give wearers the socially important though unwarranted illusion of being protected (Greenhalgh, 2020). Wearing a mask, including one made from ordinary cloth at home, is taken as a sign of personal safety and of being a responsible citizen. It adds to the moral standing of the user. Publicly questioning the efficacy of masks or respirators may be frowned upon as it augments the already generalized sense of defenselessness and thus increases stress in general. But as coronavirus experience grows, the argument that face masks offer important protection – whatever that implies – is proving to be resistant to change and is readily used for psychological, sociological, political, and legal aims. Besides what has been mentioned, the psychological function of wearing any type of face covering in a pandemic resembles collectively selecting a symbol, amulet or fetish with which to try and counter a host of fears caused by a not-yet-understood but dreaded global danger (Marks, 1987). People are being convinced or obliged to wear face coverings because the illusion of protection reduces social stress and improves social coherence, at least in part.

4. Improving communication

The public use of face masks not limited to health care settings has physical consequences with specific problems for wearers during pandemic situations, as extensively documented by Johnson (2016) and other authors (Pfefferbaum and North, 2020). There are also, of course, psychological consequences. Face coverings in health settings cause communication stress that, however, may be justifiable for medical reasons. Masks create or increment perceptual distance which earlier evidence already found to increase feelings of loneliness, possibly resulting in mood disorders (Körding et al., 2007), or to affect the personality of the wearer (Koh et al., 2006), confirmed by recent data (Killgore et al., 2020). In general, mask wearing may have psychological impacts on the psychological needs of competence, autonomy, and relatedness (Scheid et al., 2020). We here focus on what the generalized use of current types of face masks during a pandemic implies for perceived stress. Stress as referred here includes increased anxiety for biological reasons, such as from the prolonged use of face masks inducing difficulty in breathing upon exertion and excessive sweating around the mouth which results in poorer adherence and increased risk of susceptibility to infection (Purushothaman et al., 2020). Psychological reasons include anxiety and insomnia, social dysfunction, and depression (Szczesniak et al., 2020). Masks clearly hamper efficient communication. The mouth transmits the emotional content and meaning of the message, even when not speaking. Very young children already perceive messages from the speaker's mouth, such as happiness, sadness, danger or doubt. Facial recognition is an important social and psychological input for children and for adults (Freire and Lee, 2001). Most masks currently in use reduce that input drastically by making the mouth invisible. For fluent communication, a face mask should ideally be transparent. Transparent respiratory filtering materials do exist. Transparent masks would mitigate communication stress and frustration. They are

not to be confounded with transparent face shields. Face shields only offer protection against direct spurts of contaminated fluids or matter, thus they have reduced sanitary value. Nevertheless, recent opinions favoring shields have appeared in the medical press (Perencevich et al., 2020), although the attached Comments correctly criticize authors' misinterpretation of existing study results. Masks have limited efficacy, not only medically but also socially and psychologically. The effect of mask use on the wearer's stress in health care had been extensively studied well before the COVID-19 pandemic and those data show that the listener's perceived stress increases when the speaker's face is covered. This does not necessarily mean that a person wearing a face mask inspires fear, but it does heavily affect communication. For instance, most children showed to not be explicitly afraid of a physician or nurse wearing a face mask, but preferred a transparent face covering (Forgie et al., 2009). Being able to see the mouth is important for understanding what the person is trying to communicate, and not just what is being said. We also 'hear' with our eyes (Marks, 1987; Shams et al., 2000). We need to see the mouth of the person who is speaking to understand them in spite of soft or muffled speech. We lip-read. An obscured mouth increases stress in both parties, makes breathing and communicating less efficient and reduces or slows understanding. A covered mouth possibly activates genetically stored symbolic meaning. Trust, empathy and recognition are called into question when a mouth is covered. As stress reaches clinically significant levels in pandemic complications, resulting mental health problems such as depression and anxiety and their prevention, evaluation and treatment need earlier and more professional assistance (Xiong et al., 2020; Galea et al., 2020). A face mask may be taken as a stigma but data indicate that most people, especially the elderly, consider the stigma oxymoronically positive, although more mask use time affects mental health (Zhao et al., 2020). Up until the COVID-19 pandemic, face masks were primarily used in medical settings and indicative of a localized risk of contamination. With their universal and increasingly obligatory use by the general public, face masks are an omnipresent visual indication of a generalized contamination risk and question one's own and others' health. This has shown to create a surge in circumstantial distress and anxiety, increasing with duration and relating to varying degrees of direct and indirect affectation (Cortés-Álvarez et al., 2020). Conversely, mask wearing may also create a sense of belonging and of complying and sharing socially, giving psychological reassurance in times of distress.

5. Treatment: mitigating communication stress from face masks

Pandemic situations increase habitual stress, in and out of health care environments, and produce special circumstantial stress from primary (health-related) as well as from secondary psychological, social or legal sources, with negative consequences affecting widely. One such secondary source is hampered communication resulting from the use of face coverings. Pandemic containment measures include obligatory face coverings that are causing clinically relevant levels of stress, yet to be evaluated and treated in COVID-19 affected populations. As this will not be the last pandemic, society has to accept facial masks as a permanent part of human public appearance and social performance. Communication stress is relevant in all clinical situations, both for patients and for medical staff (Table 1).

Table 1
Present treatment approaches for face mask communication stress.

- *Education and training on COVID-19 related psychosocial issues
- *Stress reappraisals
- *Stress mindsets
- *Enhancing communication skills
- *Cognitive reorientation
- *Increasing coping competency
- *Increasing body language parameters
- *Therapeutic re-evaluation
- *Transparent face coverings

Presently, the solutions being proposed for communication stress caused by face masks are limited to increasing other forms of body language and patience. In general, governments recognize that **education and training on COVID-19 related psychosocial issues** should be provided to health system leaders, first responders, and health care professionals, but no specific mask-stress treatments prevail (Australian Government Department of Health, 2019). However, psychological training is known to be effective for stress reduction. Stress management training's first options are **stress reappraisals** and **stress mindsets** (Hagger et al., 2020). Promoting **changes in communication skills** and applying **cognitive reorientation** to **increase coping competency** are a clinical first:

Changes in communication skills. Face coverings prevent lip reading and muffle sound, thus reducing visual and auditory information. This loss may be compensated by training to transmit (part of) the message by an increased use of other information, such as directive touch (nudges) and compensatory visual information (clues). In other words: **increase body language.**

Cognitive reorientation centers on a therapeutic re-evaluation of what possible personal pandemic consequences mean for the person. Infection, isolation, lockdown, face coverings and other stressful concepts are often interpreted on the basis of generalized preoccupation fueled by what the media offer and on opinions of social circles. Misinformation, misinterpretation and even mass hysteria, as in Ukraine in May of 2020 (Wikipedia, 2020), may cause distress, anxiety, depression, and other mental health problems (Centers for Disease Control and Prevention (CDC), 2020.; Sandin et al., 2020).

Therapeutic re-evaluation is an effective goal-specific short cognitive behavior therapy. Mindfulness can be of value (Belen, 2020).

Transparent face coverings would be a panacea. Transparent and highly efficient filter material with particulate matter (PM) retention of 2.5 has been available for some time (Liu et al., 2015; Liu et al., 2019) and should be recommended for all types of face coverings.

Conclusion

Pandemics cause and increase health related stress, which should be considered clinically relevant and treated as early as possible. The use of non-transparent face masks produces communication stress that adds to the stress being caused by the health situation. The general public should be better informed about realistic efficacies of the different types of masks and their correct use. Possible alternatives such as transparent medical masks should be actively pursued. Coping strategies should be taught.

Research is needed into the causal sequence of communication stress and specific psychological treatment.

Declaration of Competing Interests

The author declares no conflicts of interest.

References

Asadi, S., Wexler, A.S., Copa, C.D., Barreda, S., Bouvier, N.M., Ristenpart, W.D., 2019. Aerosol emission and superemission during human speech increase with voice loudness. Sci. Rep. 9, 2348. doi:10.1038/s41598-019-38808-z, (2019).

Australian Government Department of Health (2019). https://www.health.gov.au/news/health-alerts/novel-coronavirus-2019-ncov-health-alert/ongoing-support-during-coronavirus-covid-19/looking-after-your-mental-health-during-coronavirus-covid-19-restrictions

Balachandar, S., Zaleski, S., Soldati, A., Ahmadi, G., Bourouiba, L., 2020. Host-to-host airborne transmission as a multiphase flow problem for science-based social distance guidelines. Int. J. Multiphase Flow 132, 103439. doi:10.1016/j.ijmultiphaseflow.2020.103439.

Bandaru, S.V., Augustine, A.M., Lepcha, A., Sebastian, S., Gowri, M., Philip, A., Mammen, M.D., 2020. The effects of N95 mask and face shield on speech perception among healthcare workers in the coronavirus disease 2019 pandemic scenario. J. Laryngol. Otol. 1–4. doi:10.1017/S0022215120002108, Advance online publication.

Belen, H., 2020. Fear of COVID-19 and Mental Health: The Role of Mindfulness in Time of Crisis doi:10.21203/rs.3.rs-40529/v1.

Capraro, V., Barcelo, H., 2020. The Effect of Messaging and Gender on Intentions to Wear a Face Covering to Slow Down COVID-19 Transmission May 11 doi:10.31234/osf.io/tg7vz.

Centres for Disease Control and Prevention, 2020.

Cortés-Álvarez, N.Y., Piñeiro-Lamas, R., & Vuelvas-Olmos, C.R. (2020). Psychological effects and associated factors of COVID-19 in a Mexican sample. Disaster medicine and public health preparedness, 1–12. https://doi.org/10.1017/dmp.2020.215

Dugré, N., Ton, J., Perry, D., Garrison, S., Falk, J., McCormack, J., Moe, S., Korownyk, C.S., Lindblad, A.J., Kolber, M.R., Thomas, B., Train, A., Allan, G.M., 2020. Masks for prevention of viral respiratory infections among health care workers and the public: PEER umbrella systematic review. Can. Fam. Phys. 66 (7), 509–517.

FDA (Food and Drug Administration) (2020). https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-surgical-masks-and-face-masks#s7

Forgie, S.E., Reitsma, J., Spady, D., Wright, B., Stobart, K., 2009. The "fear factor" for surgical masks and face shields, as perceived by children and their parents. Pediatrics 124 (4), e777–e781. doi:10.1542/peds.2008-3709.

Freire, A., Lee, K., 2001. Face recognition in 4- to 7-year-olds: processing of configural, featural, and paraphernalia information. J. Exp. Child Psychol. 80 (4), 347–371. doi:10.1006/jecp.2001.2639.

Galea, S., Merchant, R.M., Lurie, N., 2020. The mental health consequences of COVID-19 and physical distancing. The need for prevention and early intervention. JAMA Internal. Med. 180 (6), 817–818. doi:10.1001/jamainternmed.2020.1562.

Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., Foucault, M., 2020. Gender differences in COVID-19 attitudes and behavior: panel evidence from eight countries. Proc. Natl. Acad. Sci. U.S.A. 117 (44), 27285–27291. doi:10.1073/pnas.2012520117.

Greenhalgh, T., Schmid, M.B., Czypionka, T., Bassler, D., Gruer, L., 2020. Face masks for the public during the covid-19 crisis. Br. Med. J. 369, m1435. doi:10.1136/bmj.m1435.

Greenhalgh, T., 2020. Face coverings for the public: laying straw men to rest. J. Eval. Clin. Pract. doi:10.1111/jep.13415, First published: 26 May 2020.

Hagger, M.S., Keech, J.J., Hamilton, K., 2020. Managing stress during the coronavirus disease 2019 pandemic and beyond: reappraisal and mindset approaches. Stress Health 36 (3), 396–401. doi:10.1002/smi.2969.

Holman, E.A., Thompson, R.R., Garfin, D.R., Cohen Silver, R., 2020. The unfolding COVID-19 pandemic: a probability-based, nationally representative study of mental health in the U.S.. Sci. Adv. doi:10.1126/sciadv.abd5390, eabd5390.

ICEG (2020). https://www.health.gov.au/suites/default/files/documents/2020/07/coronavirus-covid-19-are-cloth-face-masks-likely-to-provide-protection-against-covid-19_0.pdf

IHME (2020). http://www.healthdata.org/infographic/covid19-mask-usage-meta-analysis

Johnson, A.T., 2016. Respirator masks protect health but impact performance: a review. J. Biol. Eng. 10, 4. doi:10.1186/s13036-016-0025-4.

Killgore, W.D.S., Cloonan, S.A., Taylor, E.C., Lucas, D.A., Dailey, N.S, 2020. Loneliness during the first half-year of COVID-19 lockdowns. Psychiatry Res. 294, 113551. doi:10.1016/j.psychres.2020.113551, Epub ahead of print. PMID: 33171416.

Koh, F.C., Johnson, A.T., Scott, W.H., Phelps, S.J., Francis, E.B., Cattungal, S., 2006. The correlation between personality type while wearing a respirator. J. Occup. Environ. Hyg. 3, 317–322. doi:10.1080/15459620600691264.

Körding, K.P., Beierholm, U., Ma, W.J., Quartz, S., Tenenbaum, J.B., Shams, L., 2007. Causal inference in multisensory perception. PLOS September 26, 2007. doi:10.1371/journal.pone.0000943.

Leonard, P., 2017. Exploring ways to manage healthcare professional—Patient communication issues. Support. Care Cancer 25 (Suppl 1), 7–9. doi:10.1007/s00520-017-3635-6.

Liu, C., Hsu, P.C., Lee, H.W., Ye, M., Zheng, G., Liu, N., Li, W., Cui, Y., 2015. Transparent air filter for high-efficiency PM2.5 capture. Nat. Commun. 6, 6205. doi:10.1038/ncomms7205.

Liu, H., Huang, J., Mao, J., Chen, Z., Chen, G., Lai, Y., 2019. Transparent antibacterial nanofiber air filters with highly efficient moisture resistance for sustainable particulate matter capture. iScience 19, 213–214. doi:10.1016/j.isci.2019.07.020.

Luo, M., Guo, L., Yu, M., Jiang, W., Wang, H., 2020. The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public - a systematic review and meta-analysis. Psychiatry Res. 291, 113190. doi:10.1016/j.psychres.2020.113190.

MacIntyre, C.R., Chughtai, A.A., 2020. A rapid systematic review of the efficacy of face-masks and respirators against coronavirus and other respiratory transmissible viruses for the community, healthcare workers and sick patiens. Int. J. Nurs. Stud. 108, 103629. doi:10.1016/j.ijnurstu.2020.103629.

Magnotti, J.F., Beauchamp, M.S., 2017. (2017) a causal inference model explains perception of the mcgurk effect and other incongruent audiovisual speech. PLoS Comput. Biol. 13 (2). doi:10.1371/journal.pcbi.1005229, doi.org/.

Marasinghe, K.M., 2020. Face mask use among individuals who are not medically diagnosed with COVID-19: a lack of evidence for and against and implications around early public health. Int. J. One Health 6 (2), 109–117.

Marks, I.M., 1987. Fears, Phobias, and Rituals: Panic, Anxiety, and Their Disorders. Oxford University Press, p. 1987.

Mattos Dos Santos, R., 2020. Isolation, social stress, low socioeconomic status and its relationship to immune response in Covid-19 pandemic context. Brain, Behav. Immun. - Health 7, 100103. doi:10.1016/j.bbih.2020.100103.

Moran, K.R., Del Valle, S.Y., 2016. A meta-analysis of the association between gender and protective behaviors in response to respiratory epidemics and pandemics. PLoS ONE 11 (10), e0164541. doi:10.1371/journal.pone.0164541.

New York Times (2020). 239 Experts with one big claim: the coronavirus is airborne. New York Times, July 4, 2020, nyti.ms/2VIxp67.

Nobrega, M., Opice, R., Lauletta, M.M., Nobrega, C.A., 2020. How face masks can affect school performance. Int. J. Pediatr. Otorhinolaryngol. 138, 110328. doi:10.1016/j.ijporl.2020.110328.

POST: Parliamentary Office of Science and Technology (2020). https://post.parliament.uk/covid-19-july-update-on-face-masks-and-face-coverings-for-the-general-public/

Perencevich, E.N., Diekema, D.J., Edmond, M.B., 2020. Moving personal protective equipment into the community: face shields and containment of COVID-19. JAMAJAMA 323 (22), 2252–2253. doi:10.1001/jama.2020.7477, and Comment by Campagne, D.M.

Pfefferbaum, B., North, C.S., 2020. Mental health and the Covid-19 pandemic. N. Engl. J. Med. 383, 510–512. doi:10.1056/NEJMp2008175c.

Purushothaman, P.K., Priyangha, E., Vaidhyswaran, R., 2020. Effects of prolonged use of facemask on healthcare workers in tertiary care hospital during COVID-19 pandemic. Indian J. Otolaryngol. Head Neck Surg. 1–7. doi:10.1007/s12070-020-02124-0.

Ribeiro, V.V., Dassie-Leite, A.P., Pereira, E.C., Santos, A., Martins, P., Irineu, R.A., 2020. Effect of wearing a face mask on vocal self-perception during a pandemic. J. Voice: Off. J. Voice Found. doi:10.1016/j.jvoice.2020.09.006, S0892-1997(20)30356-8. Advance online publication.

Rogers, A.H., Shepherd, J.M., Garey, L., Zvolensky, M.J., 2020. Psychological factors associated with substance use initiation during the COVID-19 pandemic. Psychiatry Res. 293, 113407. doi:10.1016/j.psychres.2020.113407.

Sandin, B., Valiente, R.M., Garcia-Escalera, J., Campagne, D.M., Chorot, P., 2020. Negative and positive effects in Spanish population during the mandatory national quarantine. Rev. Psicopatol. Psicol. Clín. 25 (1), 1–21. doi:10.5944/rppc.27569.

Scheid, J.L., Lupien, S.P., Ford, G.S., West, S.L., 2020. Commentary: physiological and Psychological Impact of Face Mask Usage during the COVID-19 Pandemic. Int. J. Environ. Res. Public Health 17 (18), 6655. doi:10.3390/ijerph17186655.

Shams, L., Kamitani, Y., Shimojo, S., 2000. What you see is what you hear. Nature 408, 788. doi:10.1038/35048669.

Szczesniak, D., Ciulkowicz, M., Maciaszek, J., Misiak, B., Luc, D., Wieczorek, T., Witecka, K.F., Rymaszewska, J., 2020. Psychopathological responses and face mask restrictions during the COVID-19 outbreak: results from a nationwide survey. Brain Behav. Immun. 87, 161–162. doi:10.1016/j.bbi.2020.05.027.

Tang, S., Mao, Y., Jones, R.M., Tan, Q., Ji, J.S., Li, N., Shen, J., Lv, Y., Pan, L., Ding, P., Wang, X., Wang, Y., MacIntyre, C.R., Shi, X., 2020 Nov. Aerosol transmission of SARS-CoV-2? Evidence, prevention and control. Environ. Int. 144, 106039. doi:10.1016/j.envint.2020.106039, Epub 2020 Aug 7. PMID: 32822927; PMCID: PMC7413047.

Wong, C.K., Yip, B.H., Mercer, S., Griffiths, S., Kung, K., Wong, M.C., Chor, J., Wong, S.Y., 2013. Effect of facemasks on empathy and relational continuity: a randomised controlled trial in primary care. BMC Fam. Pract. 14, 200. doi:10.1186/1471-2296-14-200.

WHO, 2020a. 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 395 (10242), 1973–1987. doi:10.1016/S0140-6736(20)31142-9.

WHO (Masks) 2020c. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks

WHO, 2014. Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care. World Health Organization ISBN-13: 978-92-4-150713-4 https://apps.who.int/iris/bitstream/handle/10665/112656/9789241507134_eng.pdf?sequence=1 .

Wikipedia (2020). https://en.wikipedia.org/wiki/List_of_mass_hysteria_cases

Willingham, E., 2020. The condoms of the face: why some men refuse to wear masks. Sci. Am.. June 29, 2020 https://www.scientificamerican.com/article/the-condoms-of-the-face-why-some-men-refuse-to-wear-masks/ .

Wilson, A.M., Abney, S.E., King, M.F., Weir, M.H., López-García, M., Sexton, J.D., Dancer, S.J., Proctor, J., Noakes, C.J., Reynolds, K.A., 2020. COVID-19 and non-traditional mask use: how do various materials compare in reducing the infection risk for mask wearers? J. Hosp. Infect. 105, 640–642. doi:10.1016/j.jhin.2020.05.036.

Wilson, A.M. (2020). https://www.sciencedaily.com/releases/2020/07/200708125350.htm

Xiong, J., Lipsitz, O., Nasri, F., Lui, L.M.W., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., Majeed, A., McIntyre, R.S. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. J. Affect. Disord. 277:55-64. doi: 10.1016/j.jad.2020.08.001. Epub 2020 Aug 8. PMID: 32799105; PMCID: PMC7413844.

Zhao, L., Qi, Y., Luzzatto-Fegiz, P., Cui, Y., Zhu, Y., 2020a. COVID-19: effects of environmental conditions on the propagation of respiratory droplets. Nano Lett. 20 (10), 7744. doi:10.1021/acs.nanolett.0c03331.

Zhao, S.Z., Wong, J., Wu, Y., Choi, E., Wang, M.P., Lam, T.H., 2020b. Social distancing compliance under COVID-19 pandemic and mental health impacts: a population-based study. Int. J. Environ. Res. Public Health 17 (18), 6692. doi:10.3390/ijerph17186692.

Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J., Zhao, X., Huang, B., Shi, W., Lu, R., Niu, P., Zhan, F., Ma, X., Wang, D., Xu, W., Wu, G., Gao, G.F., Tan, W.For the China Novel Coronavirus Investigating and Research Team, 2020. A novel coronavirus from patients with pneumonia in China, 2019. N. Engl. J. Med. 382, 727–733. doi:10.1056/NEJMoa2001017.