Re: Two metres or one: what is the evidence for physical distancing in covid-19?

Dear Editor

A major problem in understanding the possible role of airborne transmission in the Covid-19 pandemic has been the need to combine research findings from the biomedical, physical and social sciences. Authors from each have tended to filter the others through their own understanding rather than establishing genuine interdisciplinary collaborations to integrate these different sources of expertise. In a brief response, it is not possible to detail all the flaws in Jones et al(1) and we have selected three for specific consideration.

The Images
The study of airborne transmission has been plagued by the widespread and uncritical reproduction of still and video images – and graphics from modelling – produced under a variety of conditions and with little recognition of their limitations. Many of these rest on the use of manikins to mimic human expiration under laboratory conditions that fail to reproduce real-world conditions. Such experiments are convenient to measure and photograph, but lack verisimilitude. The two images in this paper demonstrate some of these flaws.

Figure 1 does not have a scale bar to show the distance traveled by the cloud. However, this appears to be contained within the depth of the head i.e. 20-30 cm, commensurate with more recent work of Viola et al(2). The cloud is rising due to the buoyancy of the emitted droplets and the thermal plume created by human body warmth relative to environmental temperature. It might also be added that sneezing is not a recognized symptom of Covid-19(3). Figure 2 also purports to depict a sneeze, but there is no supporting detail of the original experiment. The cloud's source is not shown and its density appears unrealistically high, although this could be due to the camera sensor's saturation from a lengthy exposure or high ISO setting. The perspective is unexplained. The image is attributed to Bourouiba(4), but seems to be derived from Scharfman et al(5) (including Bourouiba). Although Scharfman et al gives details of an experimental

set-up, this image does not appear in that paper. From Scharfman et al it is also possible that this image is associated with a third paper involving Bourouiba (though not Scharfman et al) (6), although again, the image in Fig. 2 does not appear. The similar experimental images in Bourouiba et al(6), and the corresponding modeling, show sneeze ejections traveling 70-80 cm, not 7-8 m. The shorter distance would be consistent with other recent work (2,7) and we wonder whether there has been a translation error with the units.

Emission, Ventilation, Exposure

The section 'Force of emission, ventilation, exposure time' relies mainly on case studies. The previous section, discussing air sampling studies, cautions that these 'were small, observational, and heterogeneous in terms of setting, participants, sample collection, and handling methods [and] prone to recall bias…'. The same restraint is not evident here, although the additional risks of confounding call for it. The Skagit County choir, for example, has been widely cited as evidence for airborne transmission.(8) The original authors, however, left open questions about the social interactions between choir members, and the sharing of plates of fruit and cookies, indicating the possibility of contact or fomite transmission. Singing itself has now been shown to produce only a minimal increase in aerosol mass over speaking or breathing. (9) The same is true for the various case studies of call centres and restaurants. While air flow patterns from air-conditioning or extraction systems (ventilation) may have had an effect, they are also confounded by a lack of knowledge relating to possible contact or fomite transmission. Localized air flow patterns may have an effect on the distribution of non-settling particles, but it appears as though the authors see ventilation as adding to the distribution of particles. The express purpose of ventilation is to extract non-settling particles altogether. If the flow rate is reasonable – a few times greater than the (per capita) volume humans breathe at – there is too little time to inhale infective particles before they are removed.

The Risk Assessment Chart

The main source for the assessment of distance and transmission risk appears to be Chu et al. (10) Although Jones et al acknowledge that this review has limitations, this glosses over the many severe, and likely fatal, flaws in the meta-analysis detailed by Heneghan and Jefferson(11): "As experienced reviewers, we looked at the evidence and could not replicate the distance estimates reported in the Lancet paper". Moreover, Chu et al appear not to take account of the differing ventilation conditions of the sources for their meta-analysis – which is crucial for the compilation of Figure 3. While this purports to be a usable took for risk assessment, there is no evidence of engagement with the long-established risk analysis methods(12–14) used in various sectors (including health care). The authors admit that their assessment is qualitative, but the variables are either ill-defined or undefined e.g. low/high occupancy, good/poor ventilation, volume level of the activity, short/prolonged contact time, or most importantly low/medium/high risk of transmission. The judgements used to develop the traffic-light system are not supported by any analytic methodology nor any scientific literature, including that of the indoor air quality research community(15).

The authors have ended-up creating what can be considered as a set of risk matrices, which have well-documented flaws but can be a useful tool if properly designed(16–19). The figure is solely the opinions of the authors, reflecting their pre-existing biases – advocacy-based evidence rather than evidence-based advocacy(20).

Conclusions

While Jones et al have sought to reconcile physical and biomedical approaches, the result goes mainly to show the limitations of one discipline's superficial understanding of another and the need to embrace the knowledge of a third. Using an evocative image with no explanation is unacceptable in a scientific manuscript. Frankly, this adhoc approach to risk analysis is what gives qualitative methods a bad name. The risk assessment should be supported by literature, (preferably) quantitative analysis, and it must be within an accepted methodological framework for risk assessment.

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