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# Is risk compensation threatening public health in the covid-19 pandemic?

Unfounded concerns about risk compensation threaten public health when they delay the introduction of protective measures such as wearing of face coverings, argue **Theresa Marteau and colleagues**

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Wearing face coverings, particularly in shared indoor spaces, is now mandated or recommended in more than 160 countries to reduce transmission of SARS-CoV-2.<sup>1</sup> Cloth face coverings, if correctly worn, can reduce transmission of the virus as part of a set of protective measures, including maintaining physical distance from others and good hand hygiene.<sup>2-5</sup>

Although uncertainties remain about the size of effect from including cloth face coverings in a package of measures for reducing transmission, the weight of evidence from laboratory and observational studies justifies their use.<sup>2-5</sup> Greenhalgh and colleagues recently urged policy makers to encourage the wearing of face masks because the risks are minimal and the potential impact substantial.<sup>6</sup>

Concerns have been raised, however, that wearing face coverings might lead people to forgo other protective behaviours.<sup>7-11</sup> Early in the pandemic, the World Health Organization warned that wearing medical masks when not indicated can “create a false sense of security that can lead to neglecting other essential measures such as hand hygiene practices.”<sup>8</sup> This response has been variously described as risk compensation, false reassurance, risk homeostasis, moral licensing, rebound, or negative spillover effect.

How justified are these concerns about risk compensation in the context of face coverings to reduce transmission of SARS-CoV-2? We start by examining the evidence for risk compensation in relation to other health threats.

## Risk compensation and other health threats

Risk compensation is a term widely used but with different interpretations. The central idea is that people have a target level of risk they are comfortable with and they adjust their behaviour to maintain that risk level.<sup>12</sup> In this conceptualisation, risk compensation is synonymous with the concept of risk homeostasis. It famously has its origins in opposition to driver safety regulations, with an early proponent arguing that regulations were “at best useless and at worst counterproductive.” This was based on the assumption that people offset any gain in safety with an increase in risky behaviour.<sup>13</sup> Others have used the term risk compensation to describe any change in risk behaviour, with no assumption that an increase in risky behaviour completely offsets the benefits of a safety measure.<sup>14</sup>

At an individual level, risk compensation is commonplace. For example, people run for longer to offset an eagerly anticipated indulgent meal. A cyclist

may wear a helmet to cycle at speed. However, from a population perspective, risk compensation should be judged by the average change in an outcome from which the impact of any compensating behaviour can be inferred to follow an intervention—for example, bike injuries and fatalities after mandated wearing of bike helmets.

Four interventions are often cited as leading to risk compensation: wearing of bike or ski helmets (purportedly leading to riskier cycling or skiing), circumcision to prevent HIV infection, HIV pre-exposure prophylaxis, and HPV vaccination (all purportedly leading to increased unprotected sexual activity). The results of the most recent systematic reviews for each intervention provide no evidence for an increase in any outcome deemed to reflect risk compensation (box 1).<sup>15-19</sup> For HPV vaccination, the opposite effect was found: those vaccinated were less likely to engage in unprotected sexual behaviour, as measured by self-report and rates of sexually transmitted infection.<sup>19</sup>

### Box 1: What systematic reviews conclude about risk compensation

#### Helmet wearing

- “In sum, this systematic review found little to no support for the hypothesis bicycle helmet use is associated with engaging in risky behaviour”<sup>15</sup>
- “The use of safety helmets also does not appear to increase the risk of compensation behavior as compared to non-helmeted participants in skiing and snowboarding”<sup>16</sup>

#### Pre-exposure prophylaxis to prevent HIV infection

- “One concern about PrEP [pre-exposure prophylaxis] is that its use may lead to persons at risk of HIV acquisition not using condoms or engaging in other behaviors that could increase their risk of STIs [sexually transmitted infections] (ie, behavioral risk compensation). In meta-analyses of the studies reviewed by the USPSTF [US Preventive Services Task Force], there were no differences between PrEP and placebo or no PrEP in risk of syphilis (4 trials; RR, 1.08 [95% CI, 0.98 to 1.18]), gonorrhoea (5 trials; RR, 1.07 [0.82 to 1.39]), chlamydia (5 trials; RR, 0.97 [0.80 to 1.18]), or combined bacterial STIs (2 trials; RR, 1.14 [0.97 to 1.34]).”<sup>17</sup>

#### Circumcision to prevent HIV infection

- “To date, there is little evidence from the few studies available of either unsafe practices or reported increases in risky behaviour”<sup>18</sup>

#### HPV vaccination to prevent cervical cancer

- “The consistent, replicated evidence found across the 20 studies examined in this systematic review

provides a strong body of evidence refuting that there is an association between HPV [human papillomavirus] vaccination and risky sexual behaviour<sup>19</sup>

In general, risk compensation is more likely to be reported in observational rather than experimental studies (that is, in studies at higher risk of bias). For example, a review of HIV pre-exposure prophylaxis based on observational studies reported evidence of risk compensation,<sup>20</sup> whereas a more recent review based on randomised trials did not.<sup>17</sup>

Driver safety remains one of the most contested areas regarding the existence of risk compensation. However, most studies are observational, and robust evidence synthesis is lacking. The evidence that rates of crashes and deaths have declined steadily over decades has yet to be squared with accounts of riskier driving

behaviours as safety measures have been introduced.<sup>12</sup> A more parsimonious account is one that considers behavioural responses to safety measures as part of a wider system of behavioural adaptation. In this scenario partial but not complete risk compensation might occur under some conditions.<sup>14</sup>

## Face coverings and respiratory infections

At least 22 systematic reviews have assessed the effect of wearing a mask on transmission of respiratory virus infections.<sup>6 21-41</sup> These included six experimental studies conducted in community settings that measured hand hygiene. One of these assessed the use of face masks for managing viral respiratory infections<sup>42</sup> and the remaining five for managing influenza specifically.<sup>43-47</sup> Wearing masks did not reduce the frequency of hand washing or hand sanitising in any of the six studies (table 1). Indeed, in two studies, self-reported rates of hand washing were higher in the groups allocated to wearing masks.<sup>42 44</sup>

Table 1 | Effect of wearing face masks on hand hygiene in a community setting for managing the spread of respiratory viral infections

Study	Effect on hand hygiene	
	Hand washing	Sanitiser use
Alfelali 2019 <sup>42</sup>	+	0
Aiello 2012 <sup>43</sup>	0	0
Cowling 2008 <sup>44</sup>	+	Not reported
Cowling 2009 <sup>45</sup>	0	0
Larson 2010 <sup>46</sup>	Not assessed	0
Simmerman 2011 <sup>47</sup>	0	Not assessed

See supplementary file on [bmj.com](http://bmj.com) for details of the studies.

+ = Increased hand hygiene, 0 = no effect. No studies reported a decrease (risk compensation).

All six studies were cluster randomised controlled trials and included a total of 2042 households, student residences, or Hajj tents in Hong Kong, the United States, Thailand, and Saudi Arabia.<sup>42-47</sup> All included a non-intervention group. Two studies included an intervention group comprising face masks only,<sup>42 44</sup> in which participants were provided with masks and instructed on their use. Three studies included an intervention that combined masks with a hand hygiene intervention, in which participants were provided with liquid hand soap or hand sanitiser and instructed on use.<sup>45-47</sup> One study included two face mask groups, one with and one without a hand hygiene intervention.<sup>43</sup>

Hand hygiene was measured using a mixture of self-report and volumes of soap or hand sanitiser provided as part of the study. Four studies measured soap volume,<sup>45-47</sup> and all six used self-reported measures, including frequency of hand washing and hand sanitising. The studies were designed to assess the effect of wearing masks and hand hygiene on rates of respiratory viral infection. None was designed to assess risk compensation.

None of the 22 systematic reviews of the effect of wearing a mask on respiratory virus infections included studies that assessed physical or social distancing. Through additional searches, we found three observational studies that had not been peer reviewed. These assessed the effect of mask wearing on the behaviour of others, as opposed to that of the mask wearer,<sup>48-50</sup> and all observed that people moved away from those wearing a mask. While of interest, such studies do not provide evidence to judge risk compensation by the wearer of the mask.

## Understanding interactions between protective behaviours

The idea of risk compensation may appeal to some as an example of the oddities of human behaviour. But it can be used to stop potentially effective interventions about which people hold strong views, by arguing that an intervention might be worse for a population than no intervention. There is, however, no compelling evidence that such risk compensation exists at a population level.

We do not rule out the possibility that for some people, engaging in one behaviour can influence other behaviours in ways that might attenuate their beneficial effects. But based on the evidence we review here, any attenuation is unlikely to be sufficient to counter, or even reverse, these beneficial effects and lead to a worse outcome for a population.

Aside from risk compensation, two other outcomes are possible from wearing a face covering or engaging in some other protective behaviour. Firstly, there may be no effect. This can occur if two or more behaviours, originally motivated by the same goal, become routine and are activated by different cues. For example, if wearing a face covering is cued by a sign at the entrance to a train station whereas hand washing is cued by seeing a hand sanitiser.

Secondly, people who engage in one protective behaviour may become more likely, rather than less likely, to engage in related behaviours. This can occur if protective behaviours also serve as cues to initiate other protective behaviours. For example, if wearing a face covering acts as a cue to wearers or observers to maintain a safe physical distance.<sup>51</sup>

The conditions under which any of these outcomes occurs—no effect, an increase, or a decrease in other behaviours—and how this might vary across behaviours and threats, between individuals, cultures and contextual cues, is unknown but knowable. Dropping the imprecisely used term risk compensation—with its unfounded theoretical and empirical basis—and replacing it with more meaningful terms within an approach grounded in contemporary behavioural science would do much to advance this quest.<sup>52</sup>

## Laying the theory to rest

Evidence is growing that wearing face covering reduces the spread of SARS-CoV-2, and the limited evidence available does not support concerns that their use adversely affects hand hygiene. This is in keeping with the larger body of evidence on interventions for which risk compensation has been shown to be an unfounded concern. Studies are still warranted to understand how people behave when wearing face coverings in different types of shared indoor spaces, observing not only hand hygiene but also physical distancing in both the wearers and others. Critically, these studies should be designed to evaluate how space is most effectively designed to maximise behaviours that reduce transmission of SARS-CoV-2. Such studies will also provide a context to assess how these behaviours interact, to lay to rest risk compensation as an outcome of wearing face coverings.

In 2016, Pless<sup>12</sup> argued that risk compensation theory “is a dead horse that no longer needs to be beaten.” We would add that this dead horse now needs burying to try to prevent the continued threat it poses through slowing the adoption of effective public health interventions.

### Key messages

- Risk compensation—increasing risky behaviour after adopting a protective measure—has been used to argue against public health interventions, such as face coverings to reduce transmission of SARS-CoV-2
- Available evidence does not support concerns that wearing face coverings adversely affects hand hygiene
- Evidence from other areas also indicates that risk compensation is not discernible at a population level
- The concept of risk compensation, rather than risk compensation itself, seems the greater threat to public health through delaying potentially effective interventions

Contributors and sources: TMM conceived the idea for this paper in discussion with GJR when reviewing evidence on possible behavioural responses of the general public to wearing face coverings during pandemics. They are both participants in the UK government’s Scientific Advisory Group for Emergencies (SAGE), currently responding to the covid-19 pandemic, and two SAGE subgroups: the scientific pandemic influenza group on behaviours and the environment and modelling group. EM brought expertise in systematic literature reviewing and topic expertise on risk compensation. Details of the search strategies used for this article are available from the authors on request. TMM and EM prepared the first draft of the paper to which GJR added conceptual ideas. All authors edited the manuscript before approving the final version. TMM is guarantor of the article.

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