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Brain, Behavior, and Immunity xxx (xxxx) xxx

Contents lists available at ScienceDirect

Brain Behavior and Immunity

journal homepage: www.elsevier.com/locate/ybrbi

Brief Commentary

# Predicting COVID-19 vaccine take-up: Moving beyond demographics

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As the present pandemic has unfolded, principal investigators on existing UK population-based studies – the five birth cohorts (1946, 1958, 1970, Millennium, Next Steps), the English Longitudinal Study of Ageing, the Avon Longitudinal Study of Parents and Children, and Generation Scotland, amongst others – often at the behest of domestic funding agencies, have scrambled to conduct COVID-19-orientated surveys. Coupled with data gathered pre-pandemic, these are well-placed to quantify the economic, social, and health consequences of illness, quarantine, and the lockdown more broadly, (Pierce et al., 2020) although, whether the resources invested across this large portfolio, as opposed to a greater focus on bespoke projects, will have long term value is debatable. While appearing in a journal more accustomed to high-resolution studies in the psychoneuroimmunology field, the paper in this issue by Elaine Robertson and others (Robertson et al., 2021) on the prevalence and predictors of COVID-19 vaccine hesitancy is a useful contribution using data from a study nested within another established UK cohort, Understanding Society (Burton et al., 2020).

Herd immunity refers to the notion that, once a stated majority of a population becomes immune to an infectious disease, the probability of between-person spread is substantially diminished because those who remain at risk are indirectly protected owing to the low prevalence of the disease (Desai and Majumder, 2020). Much-debated in the context of this pandemic, one view is that these conditions should be achieved by national lockdown with vaccination, while another advocates for segmentation and protection of the most vulnerable groups with the remainder returning to more normal life with herd immunity realised via community infection (Wise, 2020). Opting for the former, the UK government has distributed vaccines at unprecedented pace and scale in an initiative that at least approaches their aim of being 'world beating' when multiple other responses have been highly flawed (Looi, 2020). As efforts continue to attain herd immunity, reports of vaccine hesitancy – the refusal or delay in being vaccinated despite safety assurance and availability (MacDonald, 2015) – by no means unique to the present pandemic, (Burger et al., 2021) are concerning, and require rapid quantification and understanding.

The unveiling of several new efficacious vaccines in recent months, rendering real what was once a distant-seeming aspiration, may have contributed to the marked secular reduction in hesitancy seen across many countries (YouGov, 2021). With data on intentionality in Understanding Society serendipitously being collected immediately following the announcement of the successful testing of the Oxford University/AstraZeneca jab, the study by Robertson et al. (Robertson et al., 2021) therefore offers estimates when vaccination was a reality. In the full cohort, the prevalence of vaccine hesitancy was 18%, but this conceals stark differences across population sub-groups. Owing to its size and purposeful sampling, rarely amongst UK studies (Bécares et al., 2020), Understanding Society has a reasonable representation of people from diverse ethnic backgrounds. Whereas not every minority group was more likely to be vaccine-hesitant relative to White British/Irish study members (16%) – people defining themselves as East Asian British had the lowest prevalence (14%) – those identifying as Black British (72%) had the highest levels of reluctance, with Pakistani/Bangladeshi groups being the next most hesitant (42%) (Robertson et al., 2021). Concern about the unknown longer term side-effects was the primary reason cited amongst the equivocal cohort members. Other predictors of hesitancy described by the authors have been reported elsewhere, but in smaller-scale studies and include being female, (Detoc et al., 2020) young, (Wang et al., 2020) free of physical morbidity, (Ruiz and Bell, 2021) and less well educated (Nguyen et al., 2021).

The effects of being older and male on the elevated risk of serious manifestations of COVID-19 (Batty et al., 2020) should be partially offset by the lower self-reported vaccine hesitancy in these groups; however, by contrast, the hesitancy results for ethnicity and education would appear to represent additive burdens. Thus, relative to White individuals, people from African-Caribbean backgrounds experience up to 7 times the rates of death from COVID-19 (Batty et al., 2021) and 4 times the risk of hospitalisation for the condition (Lassale et al., 2020). The corresponding observations for poverty, with which education closely correlates, also suggest a markedly elevated risk (Batty et al., 2020) – effects that were not explained by statistical control for other risk

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https://doi.org/10.1016/j.bbi.2021.03.021
Received 22 March 2021; Received in revised form 22 March 2021; Accepted 23 March 2021
Available online 27 March 2021

factors, including systemic inflammation (Lassale et al., 2020). Robertson et al. (2021) and others call for a series of practical, evidence-based response measures to lower vaccine hesitancy and increase take-up, including maximising the use of community champions, to which one could perhaps add the placement of major vaccine centres in areas of deprivation and those with a high representation of individuals from ethnic minority backgrounds, and the endorsement of vaccination by well known celebrities of colour.

With data gathered prior to the national roll-out programme, the authors (Robertson et al., 2021) utilised vaccine intention as their outcome of interest, and its use lacked some critical reflections. Just as the willingness to subscribe to a gym would not be a satisfactory proxy for high levels of physical exertion, and the aspiration to stop smoking would not be regarded as a useful indicator of actual quitting, vaccine intention might be a poor substitute for actual uptake. In a small scale longitudinal study conducted in Hong Kong during the period of the 2009 H1N1 pandemic, of those people who expressed a commitment to being inoculated, only 10% had actually received the jab two months later (Liao et al., 2011). Elsewhere, in a US adult population at high risk of seasonal influenza, around half of those intending to be vaccinated had actually done so within 5 months (Harris et al., 2009). In older groups in the UK who were prioritised for vaccination, and also in those countries whose vaccine distribution rates exceed that of the UK such as Israel and the United Arab Emirates, examining predictors of actual take-up is now viable, warrants scrutiny, and reports will presumably follow.

Given the breadth of data available in Understanding Society, there are missed analytical opportunities in the paper by Robertson et al. (Robertson et al., 2021). None of an array of psychological factors were considered. Most obviously, cognitive function (intelligence), personality dispositions, and mental health, via their associations with other health-protecting behaviours such as cancer screening (Gale et al., 2015) and drug compliance, (Deary et al., 2009) have strong *prima facie* links to vaccination uptake. Having carried out analyses of the dataset used by Robertson and co-authors (Robertson et al., 2021), we found stepwise effects for cognitive function in the same direction as those reported by the authors for education, but statistically independent of it; that is, people who were higher on cognitive function were markedly less hesitant about vaccination (Batty, 2021). Individuals who reported symptoms of psychological distress (depression and anxiety) were also more likely to be hesitant – the reverse was apparent for physical morbidity – as were those who scored higher on the personality trait of neuroticism, and those who reported being more lonely and socially isolated (Drew Altschul, personal communication). In small-scale studies from the UK and Ireland using much briefer measures, the only other data of which we are aware, similar results were reported for cognitive ability and neuroticism(Murphy et al., 2021).

Taken together, the work of Robertson et al. (Robertson et al., 2021) and others indicates that there is an emerging set of predictors of vaccine hesitancy across the UK. Even if their results bear only modest resemblance to actual take up of COVID-19 vaccination, there is potentially useful guidance about how, where, and to whom advice and information concerning vaccination efficacy, safety, and mechanism of action could be provided with special care and thoroughness.

## Funding

GDB is supported by the UK Medical Research Council (MR/P023444/1) and the US National Institute on Aging (1R56AG052519-01; 1R01AG052519-01A1), and IJD by the UK Medical Research Council (MR/R024065/1), UK Economic and Social Research Council (ES/S015604/1), and US National Institute on Aging (1R01AG054628-01A1).

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