Article

Discriminatory attitudes against unvaccinated people during the pandemic

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During the COVID-19 pandemic, sizeable groups of unvaccinated people persist even in countries with high vaccine access[1]. As a consequence, vaccination became a controversial subject of debate and even protest[2]. Here we assess whether people express discriminatory attitudes in the form of negative affectivity, stereotypes and exclusionary attitudes in family and political settings across groups defined by COVID-19 vaccination status. We quantify discriminatory attitudes between vaccinated and unvaccinated citizens in 21 countries, covering a diverse set of cultures across the world. Across three conjoined experimental studies (n = 15,233), we demonstrate that vaccinated people express discriminatory attitudes towards unvaccinated individuals at a level as high as discriminatory attitudes that are commonly aimed at immigrant and minority populations[3–5]. By contrast, there is an absence of evidence that unvaccinated individuals display discriminatory attitudes towards vaccinated people, except for the presence of negative affectivity in Germany and the USA. We find evidence in support of discriminatory attitudes against unvaccinated individuals in all countries except for Hungary and Romania, and find that discriminatory attitudes are more strongly expressed in cultures with stronger cooperative norms. Previous research on the psychology of cooperation has shown that individuals react negatively against perceived 'free-riders'[6,7], including in the domain of vaccinations[8,9]. Consistent with this, we find that contributors to the public good of epidemic control (that is, vaccinated individuals) react with discriminatory attitudes towards perceived free-riders (that is, unvaccinated individuals). National leaders and vaccinated members of the public appealed to moral obligations to increase COVID-19 vaccine uptake[10,11], but our findings suggest that discriminatory attitudes—including support for the removal of fundamental rights—simultaneously emerged.

In a historical feat of science, highly effective vaccines against SARS-CoV-2 were developed, tested, approved and mass produced in less than a year[12]. However, it soon became clear that achieving a sufficiently high uptake of these vaccines was in itself a major challenge[13]. Despite targeted vaccine mandates, vaccine passports and massive information campaigns, sizeable groups in several countries across the world continued to refuse to get vaccinated against COVID-19, even in regions in which vaccines were widely available[1]. At the same time, many countries continued to use interventions to control infection spread, resulting in feelings of pandemic fatigue, waning support for restrictions and dwindling trust in authorities[14–16].

Against this backdrop, public debates around COVID-19 have been heated. Some politicians have justified strict policies against unvaccinated individuals using highly moralistic rhetoric[10]. At the same time, disruptive public protests directed against vaccine mandates have taken place in several Western countries[2]. Survey research shows that divisions based on vaccination status are also emerging among the public[17,18]. Individuals who comply with the advice of health authorities morally condemn unvaccinated individuals for violating a social contract in the midst of a crisis[8,9,11]. Those who refuse vaccines report that they feel discriminated against[18] and pressured against their will[19]. Furthermore, vaccination status is consistently aligned with other political opinions such as trust in science and the authorities and, in the case of the USA, partisanship[9,13,20].

Previous research shows that political divides can harm everyday interactions between citizens by eliciting general antipathy in the form of prejudice[21]. Here we provide a cross-cultural empirical investigation of the nature and level of prejudice across groups defined by COVID-19 vaccination status, covering in total 21 countries across all inhabited continents. We follow ref. [22] and define prejudice as "a negative evaluation of an individual that is significantly based on the individual's group membership" (see also refs. [23,24]). Prejudice can manifest itself in affective (for example, negative emotions), cognitive (for example, negative stereotypes) and attitudinal (for example, support for exclusion

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and discrimination) expressions of prejudiced individuals[25]. Here we investigate all three dimensions in the context of groups defined by COVID-19 vaccination status.

Research on the psychology of vaccination decisions before the COVID-19 pandemic[8] and before the implementation of COVID-19 vaccines[9] has shown that generosity in two-player behavioural economic games is indeed affected by the vaccination status of the players. Specifically, vaccinated individuals are less generous towards unvaccinated individuals but, importantly, unvaccinated individuals are not less generous towards vaccinated individuals. These findings are interpreted on the basis of the psychology of human cooperation[8]. Research on cooperation has provided strong evidence that people monitor cooperative situations for the existence of free-riders (that is, individuals who benefit from the cooperation without paying appropriate costs)[26] and react negatively towards free-riders after detection[6,7]. Vaccinations contribute to the public good of epidemic control[27], and refusal to receive a vaccination is accordingly spontaneously perceived as an instance of free-riding, motivating contributors (that is, vaccinated individuals) to withhold generosity from unvaccinated individuals[8]. As the spontaneous withholding of resources from unvaccinated individuals may incentivize vaccination, health communicators have been advised that "making the social contract explicit may help to increase vaccine uptake rates without relying on mandates"[8]. On most normative grounds, it is unproblematic if people—as shown in previous studies—are generous only towards cooperators and withhold personal resources from strangers who are known to free-ride[28].

Yet, in highly polarized contexts such as vaccinations during the COVID-19 pandemic, it is possible that these psychological processes shift in multiple important ways beyond the findings of previous research on vaccination status and generosity. First, research on the psychology of cooperation suggests that two distinct psychological motivations are activated in the context of public goods provisions: motivations to generously offer rewards to contributors and motivations to punitively impose costs on free-riders[6]. Although previous research focused on the former, it is plausible that the polarized and moralized sentiments surrounding COVID-19 vaccination activate the latter, punitive, motivations too. Thus, vaccinated people may not only suspend their generosity towards unvaccinated individuals, but may also express support for the imposition of costs on unvaccinated individuals by, for example, supporting their exclusion from social relationships or democratic rights and freedoms. Second, in this context, unvaccinated individuals may react with prejudice towards vaccinated individuals as well, grounded, for example, in perceived pressure and discrimination[18,19]. Indeed, a study examining generosity in two-player behavioural economic games after the implementation of COVID-19 vaccines found that unvaccinated individuals were also less generous towards vaccinated individuals, although ingroup favouritism was smaller than among vaccinated individuals[18]. Third, the complexity of the debates surrounding COVID-19 vaccinations may fuel negative stereotypes beyond the dimensions most relevant to cooperative dilemmas. For example, research on impression formation documents that warmth is one major dimension of impression formation, which is directly related to cooperativeness[29]. Consistent with this, research before the COVID-19 pandemic found that vaccinated individuals perceive unvaccinated individuals as less warm[8]. However, research on impression formation also documents that impressions of competence constitute another and independent evaluative dimension[29]. In the context of COVID-19 vaccines, this other dimension may also be activated as, for example, vaccinated individuals may perceive unvaccinated individuals as being unintelligent and incompetent for believing false information regarding vaccinations[30]. Discriminatory attitudes in the context of COVID-19 vaccines may therefore come to have a broader cognitive basis.

To empirically examine these possibilities, we leverage large-scale cross-national data. Specifically, we conducted three experimental studies in 21 countries (study 1; n = 64,440 observations from 10,740 respondents); six countries (study 2; n = 18,270 observations from 3,045 respondents); and in the USA (study 3; n = 14,480 observations from 1,448 respondents), studying the affective, cognitive and attitudinal dimensions of prejudice across groups defined by COVID-19 vaccination status. The dataset measures discriminatory attitudes across a diverse set of cultures from all inhabited continents of the world (Fig. 1). As previous research on the lack of generosity towards unvaccinated individuals has been limited to Western democratic contexts[8,9,18], this cross-cultural dataset sheds light on both the ubiquity of discriminatory attitudes against perceived free-riders as well as on the cross-cultural predictors of variation in the strength of such attitudes. If discriminatory attitudes against people who are not vaccinated against COVID-19 reflect the activation of anti-free-rider sentiments, such attitudes may be more strongly expressed in countries that have invested substantially in the public good of suppressing deaths from COVID-19 and, in particular, in cultures in which citizens hold moral expectations that their fellow citizens support the provisions of such goods.

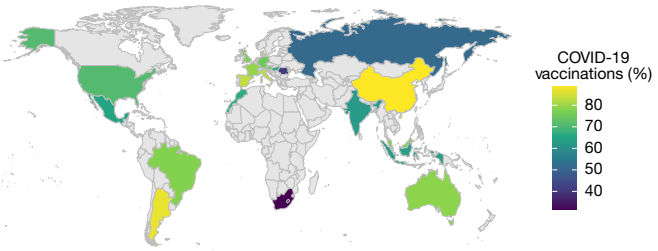

Fig. 1 | World map highlighting the countries included in study 1. Countries are coloured by the share of vaccinated citizens in the population on the first day of data collection (December 2021 to January 2022).

Exclusion from family in 21 countries

Our initial examination focuses on cross-cultural exclusionary attitudes in the context of family relationships and, specifically, the level of antipathy if a close relative was marrying an unvaccinated (versus fully vaccinated) person. Such discriminatory attitudes in family relationships have been a key focus in previous cross-national research on prejudice along racial, ethnic and partisan lines[21,31]. Exclusion from family relationships is cross-culturally relevant, independently of the legal and democratic traditions of the country; discrimination on the basis of membership in politicized groups within families has also been shown to be highly disruptive for the families[32]; and, finally, relative to other forms of discriminatory attitudes (for example, support for state-sponsored discrimination), discrimination within families is something within the control of individuals and, therefore, something that can take immediate effect.

We used conjoint experiments in which respondents evaluated fictitious target profiles simultaneously randomized on six attributes, including their COVID-19 vaccination status. The conjoint experimental design yields causal traction, provides a cost-effective method for collecting large samples and enables us to examine a wide range of responses covering affective, cognitive and attitudinal components of prejudice[33].

Given our ambition to study discriminatory attitudes rather than generosity, we depart from previous work that relied on incentivized economic games (such as the dictator game)[8,9,18]. To help assess the validity of the conjoint experimental approach, we performed a number of tests. First, we show that people perceive that measures focusing on social interactions are more ecologically valid than those focusing on monetary transactions captured by economic games (paired sample t-test, ΔM = 0.15, 95% confidence interval = 0.14–0.16, $t_{1,447}$ = 24.6,

$P < 0.001$; Extended Data Fig. 1 and Supplementary Information K), making the present findings less vulnerable to criticisms regarding ecological validity. Second, to assuage potential concerns about social desirability bias from self-reported measures, we report experimental evidence indicating that people readily and openly admit their antipathy towards vaccination outgroups, even using a traditional, direct survey question ($M = 44\%$, 95% confidence interval = 0.40–0.48). Indeed, this estimate of antipathy is not statistically different from the estimate that we get using a forced-response technique, which was specifically designed to alleviate social desirability ($M = 39\%$, 95% confidence interval = 0.35–0.43, $\chi^2_{1,1,210} = 2.31$, $P = 0.13$; Extended Data Fig. 2 and Supplementary Information L). Finally, despite the presumed advantages of incentivized behavioural measures, we demonstrate that ingroup bias in generosity across vaccination groups is identical whether estimated with incentivized measures replicating previous research ($M = 29$; 95% confidence interval = 26–32, one-sample $t_{724} = 19.4$, $P < 0.001$) or with non-incentivized, self-reported measures ($M = 30$; 95% confidence interval = 28–33, one-sample $t_{722} = 21.0$, $P < 0.001$; $\Delta M = -1.45$, 95% confidence interval = −5.5–2.6, statistically equivalent to 0, TOST two-sample t-test, $t_{1,445} = 2.16$, $P < 0.05$; Supplementary Information M).

In the conjoint experiment for study 1, we adapted a widely used instrument of exclusionary reactions in family relationships[31] and examined a specific set of discriminatory attitudes: how unhappy would respondents be if a close relative was marrying an unvaccinated versus vaccinated person. Furthermore, we assessed the potential cognitive bases for discriminatory attitudes. First, we measured a reasonable basis for antipathy towards vaccination outgroups, namely, fear of infection[34] (note that, during the collection of these studies, the vaccine-evading Omicron variant was dominant[35], and vaccine-induced immunity against infection spread was waning[36] in most societies; this increased the chances of being infected by vaccinated people and therefore decreased the risk of interacting with unvaccinated individuals relative to vaccinated individuals). Although fear of infection is probably more pronounced among vaccinated individuals, some unvaccinated individuals have been found to hold the misinformed belief that vaccinated people themselves spread COVID-19 through vaccine shedding[37]. Second, we assessed the two key negative trait impressions underlying prejudice according to research on impression formation and prejudice—perceptions of untrustworthiness and unintelligence[29].

With the help of the YouGov and Ipsos survey agencies, we collected high-quality, quota-sampled, original survey data from 21 countries that had widespread access to vaccines against COVID-19 (study 1: 64,440 observations from 10,740 respondents). The data were collected in a diverse set of cultures from all inhabited continents of the world. As described in the 'Study 1' (Data and generalizability) section of the Methods, the samples can be considered to be representative of the countries' online populations (except for India). This large, cross-cultural dataset enables us to not only quantify discriminatory attitudes in a wide range of countries, but also investigate sources of cross-cultural variation in its levels. Note that our pre-registered analyses in study 1 focus on antipathy towards outgroups, pooling across respondent vaccination status. Given that we found large asymmetries by vaccination status, we report estimates separately for vaccinated and unvaccinated respondents. However, pooled estimates—which are reported in Supplementary Information F—mirror these results very closely given the relatively small share of unvaccinated respondents.

Our results reveal that vaccinated respondents ($n = 54{,}054$) exhibit exclusionary attitudes towards unvaccinated individuals (Fig. 2 (left)). On average, vaccinated respondents were 13 percentage points (average marginal component effects (AMCE) 95% confidence interval = 12–14, $z = 25.65$, $P < 0.001$) more unhappy when presented with an unvaccinated versus fully vaccinated target. Country-level estimates range from 1 to 36 percentage points. We can reject the null (at the 5% alpha level) in 19 out of the 21 countries. Malaysia is an outlier with very high exclusionary attitudes (AMCE = 36 percentage points, 95% confidence interval = 32–41, $z = 15.3$, $P < 0.001$), whereas the results in Romania (AMCE = 1 percentage point, 95% confidence interval = −4–6, $z = 0.39$, $P = 0.69$) and Hungary (AMCE = 4 percentage points, 95% confidence interval = −1–9, $z = 1.74$, $P = 0.08$) are inconclusive (further discussion is provided in Supplementary Information G). Interaction models estimating conditional AMCEs indicate that, although we observed exclusionary attitudes across all demographic groups, they are slightly stronger among highly educated (AMCE difference of 5 percentage points), female (by 4 percentage points), more affluent (by 3.5 percentage points) and older (by 2 percentage points) respondents (all $P < 0.05$; Supplementary Information D).

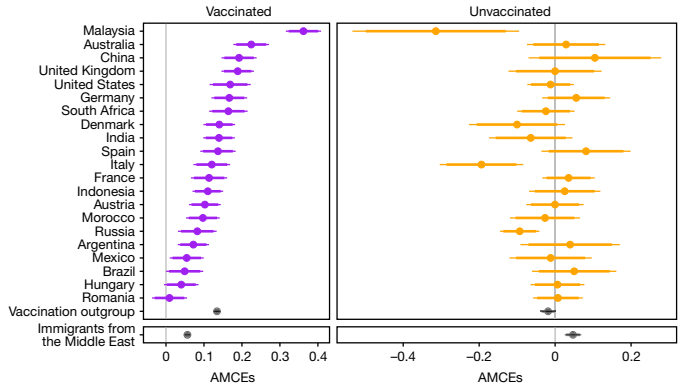

Fig. 2 | Exclusionary attitudes in family relationships towards vaccination outgroups. The average level of exclusionary attitudes in family relationships towards vaccination outgroups (that is, towards unvaccinated individuals for vaccinated respondents and towards vaccinated individuals for unvaccinated respondents; total $n = 64{,}440$). Exclusionary attitudes reflect being unhappy if a close relative married a person from the vaccination outgroup versus ingroup, with more positive coefficients indicating more exclusionary attitudes towards the outgroup relative to the ingroup. The purple and orange points denote country-level AMCE estimates ($n > 3{,}000$) for vaccinated and unvaccinated respondents, respectively. The black points denote the pooled sample and include an estimate for exclusionary attitudes towards immigrants from the Middle East. The error bars denote the 90% and 95% confidence intervals. For more details, see the 'Study 1' (Modelling) section of the Methods.

Meanwhile, unvaccinated respondents ($n = 10{,}386$) exhibit negligible exclusionary attitudes towards vaccinated individuals (Fig. 2 (right)). Their unhappiness is largely independent of the target's vaccination status, with an AMCE of only −2 percentage points (AMCE 95% confidence interval = −4–0, $z = -1.81$, $P = 0.07$; the AMCE difference between vaccinated and unvaccinated respondents is 15 percentage points; 95% confidence interval = 13–18, $z = 13.33$, $P < 0.001$). Country-level estimates of exclusionary attitudes exhibited by unvaccinated respondents are noisy owing to the small sample sizes ($90 < n < 1{,}500$), ranging between −31 and 10 percentage points. Indeed, unvaccinated individuals in Malaysia, Italy and Russia even exhibit significant exclusionary reactions towards other unvaccinated individuals ($P < 0.01$), highlighting how anti-free-rider sentiments may take priority over sentiments related to ingroup favouritism[8].

To help assess the substantive size of these effects, it is helpful to compare them with exclusionary attitudes towards a group battling high levels of discrimination in many Western countries—immigrants from the Middle East[3]. Exclusionary attitudes towards unvaccinated individuals among vaccinated people (13 percentage points) is two and a half times greater than exclusionary attitudes towards Middle Eastern immigrants (5 percentage points, 95% confidence interval = 5–6, χ^2_1 ($n = 54{,}054$) = 23.83, $P < 0.001$). We do not suggest that the characteristics of these groups are comparable, but this finding nonetheless suggests that the substantive size of the exclusionary reactions facing unvaccinated individuals is high. Supplementary Figs. E.1 and E.2 juxtapose country-level estimates of exclusionary attitudes towards the

two groups. Unvaccinated targets face significantly more exclusionary reactions compared with immigrants in 11 out of 21 countries, whereas immigrants do not face significantly more exclusionary reactions in any of the countries. Notably, exclusionary attitudes towards immigrants between vaccinated and unvaccinated individuals are substantively similar and not significantly different from 0 (n = 64,440, AMCE difference 1 percentage point, 95% confidence interval = −1–3, z = 0.88, P = 0.38), implying that asymmetry in the domain of vaccination cannot be easily explained by omitted variables or design effects (Supplementary Fig. E.3). Moreover, we did not find evidence that unvaccinated immigrants from the Middle East face disproportionate exclusionary attitudes compared with unvaccinated native individuals (n = 64,440, AMCE difference 1 percentage point, 95% confidence interval = 0–1, z = 1.1, P = 0.27; Supplementary Fig. E.4).

Stereotypes and exclusionary attitudes

Next, we examined whether exclusionary attitudes reflect a heightened risk of infection or also activate more fundamental stereotypes. As displayed in Extended Data Fig. 3a, we find large experimental effects of vaccination status among vaccinated respondents on fear of infection (n = 54,054, 38 percentage points, 95% confidence interval = 37–40, z = 65.99, P < 0.001) and perceptions of untrustworthiness (13 percentage points, 95% confidence interval = 12–14, z = 27.36 P < 0.001). However, we also find an effect on incompetence (14 percentage points, 95% confidence interval = 13–15, z = 29.00, P < 0.001), suggesting that stereotypes of unvaccinated individuals extend beyond the domain of free-riding. As unvaccinated respondents (n = 10,386) exhibit insubstantial exclusionary reactions, it is not surprising that they also do not judge vaccinated respondents as untrustworthy (0 percentage points, 95% confidence interval = −2–2, z = 0.2, P = 0.84) or as incompetent (0 percentage points, 95% confidence interval = −2–2, z = 0.37, P = 0.71) either. If anything, they fear getting infected with SARS-CoV-2 by vaccinated people slightly less than by unvaccinated people (−2 percentage points, 95% confidence interval = −5–0, z = −2.1, P < 0.05). Country-level estimates of negative stereotypes against vaccination outgroups are shown in Supplementary Information C.

Our study also replicates a well-known finding from the impression-formation literature: impressions of trustworthiness have the greatest impact on overall exclusionary attitudes[29]. On the basis of a linear regression with respondent fixed effects, exclusionary attitudes are more closely associated with impressions of untrustworthiness (β = 0.24, 95% confidence interval = 0.23–0.25) than with impressions of incompetence (β = 0.17, 95% confidence interval = 0.16–0.18, Wald test for equal effects: χ^2_1 (n = 64,440) = 62.6, P < 0.001), or even infection concerns (β = 0.16, 95% confidence interval = 0.15–0.17, Wald test for equal effects: χ^2_1 (n = 64,440) = 112, P < 0.001; Extended Data Fig. 3b). Although concerns about infection risks do shape exclusionary attitudes towards unvaccinated individuals, these findings suggest that negative stereotypes further enhance these attitudes.

Culture and exclusionary attitudes

The results provide strong evidence that exclusionary attitudes against perceived free-riders in the domain of vaccinations emerge reliably across cultures, reflecting the deep-seated nature of the psychology of cooperation[6]. At the same time, it is clear that the strength of the observed exclusionary attitudes exhibits substantial cross-cultural variation (formal evidence is provided in Supplementary Information O.1). Figure 3 shows exclusionary attitudes towards unvaccinated individuals by vaccinated respondents against three pre-registered macro-indicators—COVID-19 deaths and vaccinations (both standardized to population size) and social trust—as well as the exploratory indicator cultural tightness. Whereas COVID-19 deaths and vaccination rates indicate society-wide investments in the public good of suppressing the epidemic, social trust (that is, the tendency to trust fellow citizens) and cultural tightness (that is, the strength of social norms and the degree of sanctioning within societies[38]) are indicators of the moral expectations of fellow citizens and the willingness to sanction violations of these expectations. Countries that managed to keep the number of deaths due to COVID-19 low show strong exclusionary attitudes towards unvaccinated individuals at around 20 percentage points on average. By contrast, countries that struggled to mitigate the epidemic show much lower exclusionary attitudes. The Spearman's rank-order correlation between death and prejudice is ρ_{21} = −0.62, 95% confidence interval = −0.83 to −0.26. At the same time, the association of exclusionary attitudes with actual vaccination levels is inconclusive ρ_{21} = 0.38 (95% confidence interval = −0.06–0.70). Although there is a tendency for nations with a high level of vaccination to display more exclusionary attitudes, and countries with lower compliance to display less, there are also considerable deviations from this trend, with outliers such as Argentina (high vaccination, low prejudice) and South Africa (high prejudice, low vaccination). In Supplementary Information G, we analyse policy stringency, which is a direct measure of how much national governments invested in suppressing infections. We find no reliable association between stringency and prejudice towards unvaccinated individuals (ρ_{21} = 0.23 95% confidence interval = −0.22–0.6; Extended Data Fig. 4).

Previous research demonstrated that epidemic suppression hinges on citizens' normative and moral expectations such that countries with higher social trust[39] and a tighter culture[40] suppressed the epidemic toll more effectively. As shown in Fig. 3, these cultural differences are also associated with higher prejudice towards unvaccinated individuals. Specifically, exclusionary attitudes are higher in countries with higher social trust (Spearman's ρ_{21} = 0.57, 95% confidence interval = 0.19–0.81). In countries in which large majorities believe that 'most people can be trusted', the exclusionary reaction towards unvaccinated individuals is greater. Meanwhile, in countries in which most people believe that 'you need to be very careful in dealing with people', exclusionary attitudes are lower. Similarly, exclusionary attitudes are higher in countries with a tighter culture, oriented towards strong norms and the sanctioning of norm violations (ρ_{16} = 0.62, 95% confidence interval = 0.18–0.85). These latter associations suggest that cultures that place stronger moral expectations on individuals not only more effectively produce the public good of epidemic control[39,40] but also constitute a fertile ground for exclusionary attitudes against unvaccinated individuals, as they may be perceived to free-ride on the collective effort[8]. In Supplementary Information O.2, we provide robustness checks for these cross-cultural conclusions, addressing potential threats to the generalizability of data obtained through online surveys.

Antipathy across six countries

In study 2, we focused on the affective component of prejudice. Specifically, we conducted a pre-registered, conceptual replication of study 1 and, in the context of a conjoint experiment, asked the participants to rate fictitious individuals that vary in terms of vaccination status (as well as other attributes) on a seven-point like–dislike scale.

Study 1 also showed that exclusionary attitudes are intertwined with a fear of infection. Although fear of infection is a weaker correlate of exclusionary attitudes compared with trustworthiness impressions, the finding nonetheless raises the possibility that prejudice against unvaccinated individuals may be restricted to relationships characterized by physical interaction. The focus on pure antipathy in a neutral evaluation task enabled us to examine this possibility. Furthermore, to gain perspective on the level of antipathy across vaccination groups, in study 2, we also changed the benchmark group from Middle Eastern migrants to a more diverse set of four groups that are also frequent targets of prejudice: drug addicts, ex-convicts, people with mental illnesses and atheists[4,5,41]. These groups were chosen to offer some

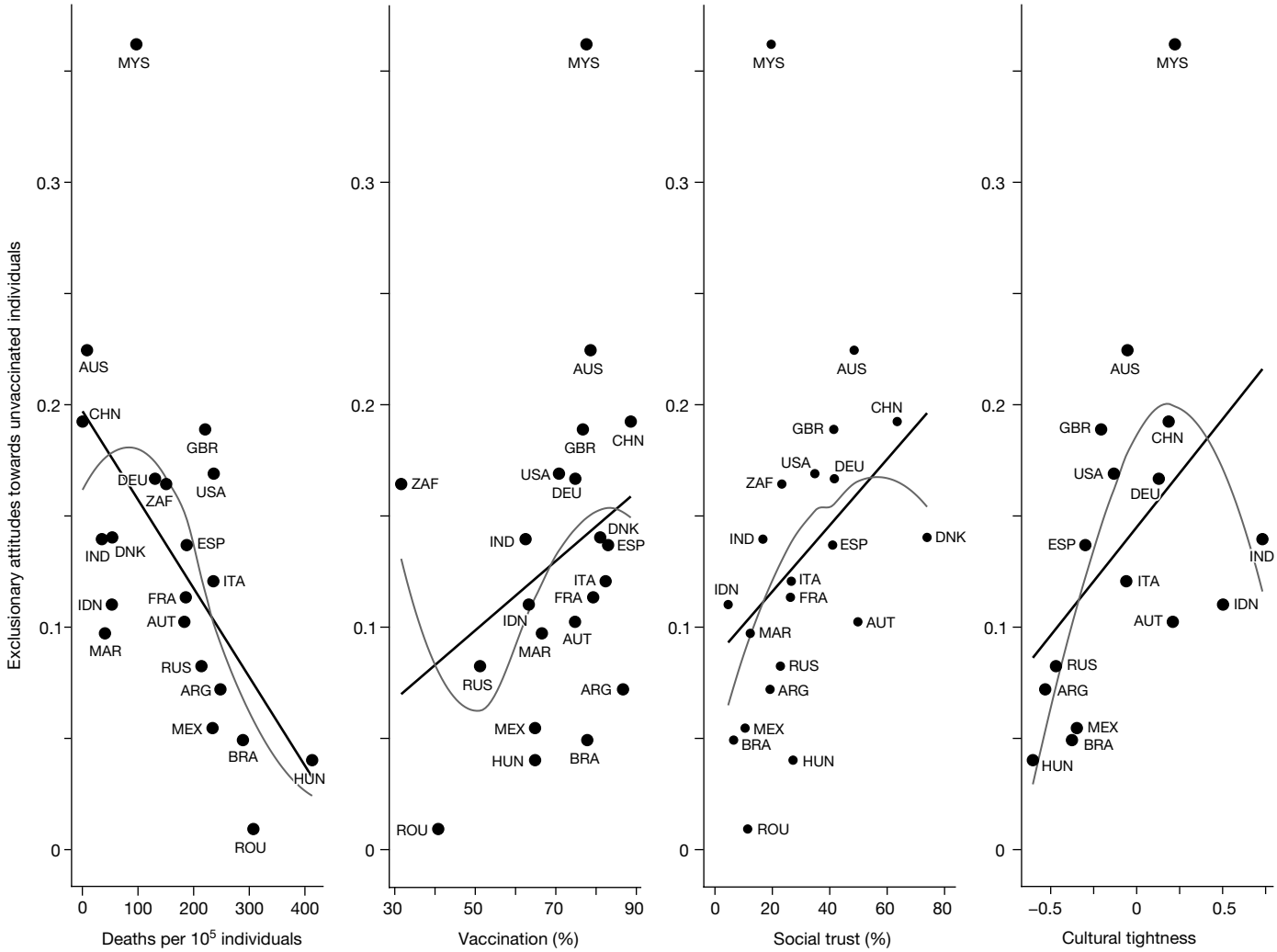

Fig. 3 | The relationship between country-level indicators and cross-national levels of exclusionary attitudes among vaccinated individuals towards unvaccinated individuals. The country-level indicators are country-level deaths from COVID-19; the national proportion of people expressing trust towards fellow citizens; the national proportion vaccinated against COVID-19; and cultural tightness scores. The labelled dots denote countries; the straight black lines denote best-fitting regression lines; and the grey curves denote loess curves. Spearman's rank-order correlations across the four facets: deaths, $\rho_{21} = -0.62$, 95% confidence interval = −0.83 to −0.26; social trust, $\rho_{21} = 0.57$, 95% confidence interval = 0.19–0.81; vaccination, $\rho_{21} = 0.38$, 95% confidence interval = −0.06–0.70; tightness, $\rho_{16} = 0.62$, 95% confidence interval = 0.18–0.85. Total $n = 64{,}440$.

variance on how much perceived control people have in determining their group membership and how much of a threat they pose on members of society.

With the help of the YouGov survey agency, study 2 was fielded in six countries (Germany, India, Indonesia, Morocco, South Africa and the UK), representing both Western affluent and non-Western developing nations. We recruited about 500 respondents per country, quota sampled on age, gender and region, as well as education in Germany and the UK (see Supplementary Information A). As before, each participant rated three pairs of target profiles (study 2: 3,045 respondents, 18,270 observations). All analyses, unless otherwise noted, were pre-registered (see Data Availability).

Our analyses show that vaccinated individuals feel antipathy towards unvaccinated individuals, even in a neutral evaluation task without any indication that the participants would physically meet the fictitious targets (Fig. 4). Across all six countries, we found that vaccinated respondents ($n = 15{,}966$) dislike unvaccinated targets more than vaccinated targets, on average by 14 percentage points (AMCE 95% confidence interval = 13–15, $z = 25.94$, $P < 0.001$). By contrast, unvaccinated respondents ($n = 2{,}304$) on average do not dislike vaccinated targets significantly more than unvaccinated targets (AMCE = 1 percentage points, 95% confidence interval = −1–4, $z = 1.01$, $P = 0.31$, although Germany is a significant outlier, AMCE = 8 percentage points, 95% confidence interval = 3–13, $z = 3.12$, $P < 0.001$). Note also that the substantive size of the antipathy expressed towards unvaccinated individuals remains high relative to the more diverse set of benchmarks. On average across the six countries, unvaccinated individuals are disliked as much as people who struggle with drug addiction (15 percentage points, 95% confidence interval = 13–16, Wald test for equal effects: χ^2_1 ($n = 15{,}966$) = 0.51, $P = 0.47$), and significantly more so than people who have been in prison (10 percentage points, 95% confidence interval = 9–11, χ^2_1 ($n = 15{,}966$) = 18.4, $P < 0.001$), who are atheists (7 percentage points, 95% confidence interval = 6–8, χ^2_1 ($n = 15{,}966$) = 67.5, $P < 0.001$) or who have a mental health illness (6 percentage points, 95% confidence interval = 5–7, χ^2_1 ($n = 15{,}966$) = 87.9, $P < 0.001$). Country-level estimates of antipathy towards each of the four benchmarks are provided in Supplementary Information I.

Study 2 included an additional test. The finding from study 1 (that is, the widespread existence of exclusionary attitudes in personal relationships) may be less concerning if members of the groups of vaccinated and unvaccinated individuals are only weakly acquainted across group boundaries and if—consistent with intergroup contact

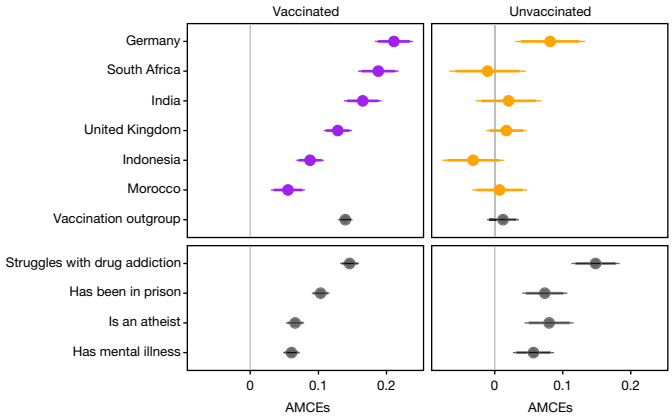

Fig. 4 | Antipathy towards vaccination outgroups. The average level of antipathy towards vaccination outgroups (that is, towards unvaccinated individuals for vaccinated respondents and towards vaccinated individuals for unvaccinated respondents; total $n = 18{,}270$). Antipathy reflects disliking a person from the vaccination outgroup versus the ingroup, with more positive coefficients indicating higher relative antipathy for the outgroup. The purple and orange points denote country-level AMCE estimates ($n > 3{,}000$) for vaccinated and unvaccinated respondents, respectively. The black points denote the pooled sample and include estimates for antipathy towards various other common targets of prejudice. The error bars denote the 90% and 95% confidence intervals. For more details, see the 'Study 2' (Modelling) section of the Methods.

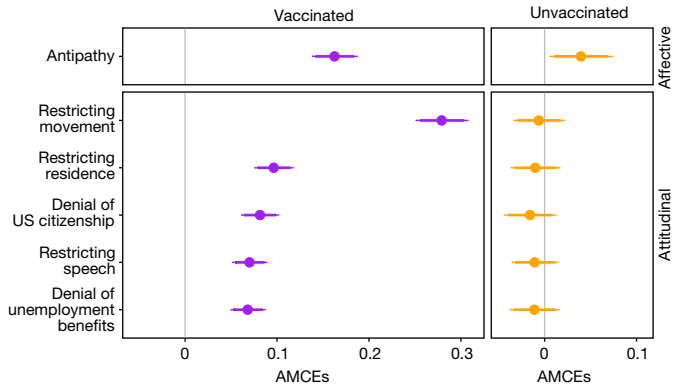

Fig. 5 | Affective and attitudinal prejudice against vaccination outgroups. Affective and attitudinal prejudice against vaccination outgroups in the USA (that is, towards unvaccinated individuals for vaccinated respondents and towards vaccinated individuals for unvaccinated respondents; $n = 14{,}480$). Prejudice reflects relative antipathy towards and support for restricting the rights and freedoms of the outgroup relative to the ingroup. More positive coefficients indicate higher prejudice. The purple and orange points denote AMCEs among vaccinated and unvaccinated respondents, respectively. The error bars denote the 90% and 95% confidence intervals. For more details, see the 'Study 3' (Modelling) section of the Methods.

theory—prejudice is high only among individuals with less intergroup contact[42]. Study 2 therefore measured how many relatives and friends respondents have who belong to the vaccination outgroup. The analyses demonstrate that, although antipathy is indeed highest among people with no contact with the outgroups ($n = 18{,}270$, AMCE = 15 percentage points, 95% confidence interval = 13–16, $z = 20.36$, $P < 0.001$), it is substantial across all contact levels (AMCEs = 5–12 percentage points, $z \geq 2.4$, $P < 0.05$; Extended Data Fig. 5 and Supplementary Information J).

Restriction of rights in the USA

So far, the discriminatory attitudes we have investigated have been demonstrated only in the domain of private relationships. Thus, study 3 examined whether discriminatory attitudes extend into the domain of publicly recognized rights. As the recognition of such rights differs across cultures, study 3 was conducted in the USA—a country with historical recognition of fundamental rights and freedoms[43]. Study 3 was identical to study 2, except that the study also included five new outcomes in addition to the measure of antipathy, and the answers were obtained on binary scales. Specifically, respondents were asked to evaluate the target's freedom of movement ("This person should be allowed to sit next to me in public transportation"), freedom of residence ("This person should be allowed to move into my neighbourhood"), freedom of speech ("This person should be allowed to express their political views on social media freely, without fear of censorship"), access to citizenship ("This person should receive US citizenship, if they are eligible and apply for it") and access to unemployment benefits ("This person should receive unemployment benefits, if they are eligible and apply for it"). We collected data through YouGov from 1,448 US Americans quota sampled on age, gender, region, education and race. Each respondent evaluated five pairs of targets yielding a final sample size of 14,480 observations. All analyses, unless otherwise noted, were pre-registered (see Data availability). The survey also included the methodological studies discussed in relation to study 1, which are reported in detail in Supplementary Information K–M.

The results (Fig. 5) demonstrate that exclusionary attitudes are not restricted to the domain of private relationships. Vaccinated Americans not only feel greater antipathy towards unvaccinated Americans by 16 percentage points (95% confidence interval = 14–19, $z = 13.09$, $P < 0.001$), but they are also 28 percentage points less likely to respect their freedom of movement (95% confidence interval = 25–31, $z = 19.4$, $P < 0.001$), 10 percentage points less likely to respect their freedom of residence (95% confidence interval = 8–12, $z = 9.1$, $P < 0.001$), 8 percentage points less likely to support their application for citizenship (95% confidence interval = 6–10, $z = 7.98$, $P < 0.001$) and 7 percentage points less likely both to respect their freedom of speech and to support their applications for welfare benefits (95% confidence interval = 5–9, $z = 7.23$ and 7.44, respectively, $P < 0.001$). Vaccinated respondents expressed significantly higher exclusionary attitudes towards unvaccinated individuals than against atheists on all six outcomes, against mentally ill on five outcomes, and against individuals who have been in prison or struggle with drug addiction on three outcomes. By contrast, they do not express significantly higher exclusionary attitudes towards any of the benchmark groups on any of the outcomes compared with unvaccinated individuals (details on all Wald tests are provided in Supplementary Information I).

The results of study 3 also indicate that unvaccinated Americans also have some negative sentiment towards vaccinated individuals (4 percentage points, 95% confidence interval = 1–7), but unvaccinated Americans are neither more nor less likely to restrict their rights or freedoms. Finally, additional analyses (Supplementary Information N) indicate that the antipathy of vaccinated Americans towards unvaccinated individuals is predictive of their support for restricting the rights of unvaccinated individuals (Spearman's rank order correlations $0.35 < \rho_{1,448} < 0.44$).

Discussion

Research on political polarization warns that, if sociopolitical disagreement—even if based on legitimate grievances—permeates interactions between citizens, it can contribute to the entrenchment of conflict[21]. Here we show that individuals who are vaccinated against COVID-19 express negative attitudes against unvaccinated individuals in the form of antipathy, stereotypes, support for exclusion from family relationships and support for removal of political rights. In total, these four forms of discriminatory attitudes are consistent with the observation of prejudice according to standard definitions in social psychology.

We examined and obtained evidence in support of all four reactions in the USA. In the other countries, we examined only some but not all forms of discriminatory attitudes and found evidence in support of the specific negative reactions examined. The only exceptions were Hungary and Romania, in which we did not find evidence in support of discriminatory attitudes. Furthermore, we found that discriminatory attitudes towards unvaccinated individuals is as high or higher than discriminatory attitudes directed towards other common and diverse targets of prejudice including immigrants, drug-addicts and ex-convicts. At the same time, the results demonstrate that prejudice is mostly one-sided. Only in the USA and Germany did we find that unvaccinated individuals feel some antipathy towards vaccinated individuals but even here we did not find statistical evidence in favour of negative stereotyping or exclusionary attitudes.

The finding that vaccinated individuals are prejudiced against unvaccinated individuals but that there is no evidence for the reverse is consistent with studies on the psychology of cooperation[6,7] and previous research on vaccinations. The cue that someone refuses to take up a vaccine activates psychological mechanisms designed to deter perceived free-riders among vaccinated individuals[8,9]. Consistent with the deep-seated nature of anti-free-rider sentiments, the observation of substantial and culturally widespread discriminatory attitudes, including support for denial of fundamental rights, suggests that negative reactions are easily triggered in the context of perceived public goods. At the same time, the results also reveal that some cultures are especially prone to react with prejudice. Consistent with an anti-free-rider perspective, vaccinated individuals in cultures with stronger cooperative norms react more negatively against unvaccinated individuals. Such norms are more reliably associated with cross-cultural differences in discriminatory attitudes than actual country-level differences in government efforts to produce epidemic control. What seems to trigger discriminatory attitudes towards unvaccinated individuals is less governments' efforts to reduce deaths from COVID-19 and more how such efforts resonate with larger cultural norms and perceived obligations.

In this regard, note that the decision to refuse vaccination against COVID-19 may reflect many factors beyond a moral failure to appreciate collective goals. A recent review of almost 100 empirical studies identified 18 robust correlates of COVID-19 vaccine hesitancy in high-income countries[44]. Even if negative stereotypes are statistically true, they are unlikely to adequately capture the full motivations of every individual. For example, an unvaccinated person may have medical conditions[45], immunity from previous infection[46], a history of mental health issues that may intensify fear of vaccinations[47], negative past experiences with health authorities (especially as members of a minority group)[48], concerns due to country-specific public health scandals[49] or ethical considerations about vaccine equity[50].

Although moralistic communication of collective responsibilities may be an effective strategy to increase vaccination uptake[8], such strategies may have unintended negative consequences in the form of eliciting prejudice[51], especially in cultures with strong cooperative norms. Research on prejudice towards minority groups warns that experiences of prejudice and discrimination may have negative long-term effects, hurting well-being[52], eroding identification with majority society[53] and driving mistrust of the state, including health authorities[54]. If the consequences of prejudice towards unvaccinated individuals resemble the consequences of prejudice against minority groups, they may exacerbate the mistrust and alienation that led to vaccine refusal in the first place[13,20].

In the short run, prejudice towards unvaccinated individuals may complicate pandemic management. In the long run, it may mean that societies leave the pandemic more divided than they entered it. Finally, our findings also offer a lesson for global challenges beyond the current pandemic. Large social crises—for example, the climate crisis—are often characterized by collective action dilemmas due to the need for substantial behaviour change among the public[55]. To effectively manage such crises, the authorities should seek to avoid fuelling deep animosity between citizens. Indeed, as moral condemnation is often easily and spontaneously activated among the public during a crisis[11], the authorities and politicians should consider tempering social animosities as an important part of their mandate, especially when societal conflict becomes more entrenched.

Online content

Any methods, additional references, Nature Portfolio reporting summaries, source data, extended data, supplementary information, acknowledgements, peer review information; details of author contributions and competing interests; and statements of data and code availability are available at https://doi.org/10.1038/s41586-022-05607-y.

1. Troiano, G. & Nardi, A. Vaccine hesitancy in the era of COVID-19. *Publ. Health* **194**, 245–251 (2021).
2. Karafillakis, E., Van Damme, P., Hendrickx, G. & Larson, H. J. COVID-19 in Europe: new challenges for addressing vaccine hesitancy. *Lancet* **399**, 699–701 (2022).
3. Bansak, K., Hainmueller, J. & Hangartner, D. How economic, humanitarian, and religious concerns shape european attitudes toward asylum seekers. *Science* **354**, 217–222 (2016).
4. Gervais, W. M. et al. Global evidence of extreme intuitive moral prejudice against atheists. *Nat. Hum. Behav.* **1**, 0151 (2017).
5. Pescosolido, B. A., Medina, T. R., Martin, J. K. & Long, J. S. The "backbone" of stigma: identifying the global core of public prejudice associated with mental illness. *Am. J. Publ. Health* **103**, 853–860 (2013).
6. Price, M. E., Cosmides, L. & Tooby, J. Punitive sentiment as an anti-free rider psychological device. *Evol. Hum. Behav.* **23**, 203–231 (2002).
7. Fehr, E. & Gächter, S. Altruistic punishment in humans. *Nature* **415**, 137–140 (2002).
8. Korn, L., Böhm, R., Meier, N. W. & Betsch, C. Vaccination as a social contract. *Proc. Natl Acad. Sci. USA* **117**, 14890–14899 (2020).
9. Weisel, O. Vaccination as a social contract: the case of COVID-19 and US political partisanship. *Proc. Natl Acad. Sci. USA* **118**, e2026745118 (2021).
10. Jørgensen, F., Bor, A. & Petersen, M. B. Increased pressure leads to decreased trust among the unvaccinated: effects of the announcement of the reintroduction of COVID passports in Denmark. Preprint at *PsyArXiv* https://doi.org/10.31234/osf.io/j49zg (2021).
11. Bor, A., Jørgensen, F., Lindholt, M. F. & Petersen, M. B. Moralizing the COVID-19 pandemic: self-interest predicts moral condemnation of other's compliance, distancing and vaccination. *Polit. Psychol.* https://doi.org/10.1111/pops.12835 (2022).
12. Kashte, S., Gulbake, A., El-Amin III, S. F. & Gupta, A. COVID-19 vaccines: rapid development, implications, challenges and future prospects. *Hum. Cell* **34**, 711–733 (2021).
13. Lindholt, M. F., Jørgensen, F., Bor, A. & Petersen, M. B. Public acceptance of COVID-19 vaccines: cross-national evidence on levels and individual-level predictors using observational data. *BMJ Open* **11**, e048172 (2021).
14. Jørgensen, F., Bor, A., Rasmussen, M. S., Lindholt, M. F. & Petersen, M. B. Pandemic fatigue fueled political discontent during the COVID-19 pandemic. *Proc. Natl Acad. Sci. USA* **119**, e2201266119 (2022).
15. Bor, A., Jørgensen, F. & Petersen, M. B. The COVID-19 pandemic eroded system support but not social solidarity. Preprint at *PsyArXiv* https://doi.org/10.31234/osf.io/qjmct (2021).
16. Lilleholt, L., Zettler, I., Betsch, C. & Böhm, R. Pandemic fatigue: measurement, correlates, and consequences. Preprint at *PsyArXiv* https://doi.org/10.31234/osf.io/2xvbr (2020).
17. Schuessler, J., Dinesen, P. T., Østergaard, S. D. & Sønderskov, K. M. Public support for unequal treatment of unvaccinated citizens: evidence from Denmark. *Soc. Sci. Med.* **305**, 115101 (2022).
18. Henkel, L., Sprengholz, P., Korn, L., Betsch, C. & Böhm, R. The association between vaccination status identification and societal polarization. *Nat. Hum. Behav.* https://doi.org/10.1038/s41562-022-01469-6 (2022).
19. Rosenfeld, D. L. & Tomiyama, A. J. Jab my arm, not my morality: perceived moral reproach as a barrier to COVID-19 vaccine uptake. *Soc. Sci. Med.* **294**, 114699 (2022).
20. Petersen, M. B., Bor, A., Jørgensen, F. & Lindholt, M. F. Transparent communication about negative features of covid-19 vaccines decreases acceptance but increases trust. *Proc. Natl Acad. Sci. USA* **118**, e2024597118 (2021).
21. Iyengar, S., Lelkes, Y., Levendusky, M., Malhotra, N. & Westwood, S. J. The origins and consequences of affective polarization in the United States. *Ann. Rev. Polit. Sci.* **22**, 129–146 (2019).
22. Crandall, C. S. & Eshleman, A. A justification-suppression model of the expression and experience of prejudice. *Psychol. Bull.* **129**, 414–446 (2003).
23. Dixon, J., Levine, M., Reicher, S. & Durrheim, K. Beyond prejudice: are negative evaluations the problem and is getting us to like one another more the solution? *Behav. Brain Sci.* **35**, 411–425 (2012).
24. Gibson, J. L., Claassen, C. & Barceló, J. in *At the Forefront of Political Psychology: Essays in Honor of John L. Sullivan* (eds Borgida, E. et al.) 55–78 (Routledge, 2020).
25. Stangor, C., Sullivan, L. A. & Ford, T. E. Affective and cognitive determinants of prejudice. *Soc. Cogn.* **9**, 359–380 (1991).
26. Cosmides, L. & Tooby, J. in *The Handbook of Evolutionary Psychology* (ed. Buss, D. M.) 584–627 (Wiley, 2015).
27. Ahlskog, R. *Essays on the Collective Action Dilemma of Vaccination*. PhD thesis, Acta Universitatis Upsaliensis (2017).
28. Schauer, F. *Profiles, Probabilities, and Stereotypes* (Harvard Univ. Press, 2006).