



Fig. 2. Vaccine confidence by world region and differences between perceived safety and importance. (A) Summary of Likert Responses by world region. (B) Pearson correlations between percentage of respondents across all countries agreeing ("strongly agree" or "tend to agree") with each statement. (C) Vaccine World map of percentage negative ("tend to disagree" or "strongly agree") survey responses to the statement "overall I think vaccines are safe". (D) Differences in the proportion of people responding that they believe vaccines are important but unsafe (with 95% confidence intervals).

In EUR, vaccine safety and importance are concerns, though there is relatively little reported religious incompatibility. In WPR, however, great concerns are expressed about safety, importance, and religious compatibility (Fig. 2A). Pearson correlations between the fractions of negative responses (across countries) between questions reveals that responses are more consistent among vaccine importance, safety, and effectiveness than with religious compatibility (Fig. 2B). A notable trend is the observation that the number of respondents who report more positive sentiment for vaccine importance is larger than that for vaccine safety. The striking consistency in this trend across most of the countries surveyed is clear in Fig. 2C. This suggests that vaccination intent could be buffered by perceived importance, suggesting that people are willing to take a risk given an effective guard against disease. As suggested by the correlation in responses of vaccine importance and vaccine safety, individual responses between vaccine effectiveness and vaccine safety are very similar (see Supplementary material), though we note a higher fraction of countries with no significant difference and some countries with a higher fraction of respondents reporting that vaccines are safe then effective (Nigeria, Ghana, Pakistan, Indonesia, and Bangladesh).

Worldwide levels of vaccine-safety skepticism are mapped in Fig. 2C. With the notable exceptions of France and Italy – which have high levels of safety-based vaccine skepticism – Western and Northern European countries express less concern about vaccine safety than Eastern and Southern European countries. Spatial contiguity is not limited to Europe: USA, Canada, and Mexico have higher levels of safety concerns than countries in South America; and China, Mongolia, Japan, Hong Kong, and Vietnam all have high fractions of negative responses.

Results of the logistic hierarchical model employed to investigate the link between both individual- and country-level predictors, and attitudes towards immunizations are shown in Table 1. To compare data

on different scales, country-level factors have been z-scored so that a unit increase in country-level factor is associated with the reported odds ratios. Parameters with p -values lower than 0.05 are considered.

Males are less likely to think vaccines are important than females (odds ratio [OR] 0.86, 95% confidence interval [CI] 0.80 to 0.94), but there are no significant differences between the sexes for vaccine safety, effectiveness, or religious compatibility. Those aged 25–34 are less likely to believe vaccines are safe compared to 18–24 year olds (OR 0.88, CI 0.77–1.00); over 65 s are both more likely to report that vaccines are effective (OR 1.39, CI 1.11–1.76) and to express religious incompatibilities (OR 1.27, CI 1.05–1.53). Any level of education elevates positive views towards immunizations for vaccine importance, effectiveness, and religious compatibility; yet, notably, not for vaccine safety. Masters/PhD – the highest educational level – is not associated with more positive views on vaccine importance and effectiveness than those with no education. The fifth income quintile is associated with less positive vaccine sentiment across all four statements than higher income bands. Those unemployed are more likely to hold negative sentiment for vaccine safety (OR 0.77, CI 0.67–0.90) and effectiveness (OR 0.79, CI 0.67–0.92) than the baseline group. Compared to Roman Catholics, religious groups – including atheists/agnostics and with possible exceptions of Hindus and Jews – are less likely to hold positive vaccine sentiment for vaccine importance and vaccine safety. Other Christians and atheists/agnostics are more likely to have religious compatibility issues; however, it should be noted that it is unclear whether atheists/agnostics could have reasonably answered this question, since the phrasing assumed that the respondent's religiosity.

For vaccine importance, countries with higher levels of births attended by skilled health staff (OR 0.66, CI 0.49–0.88) and schooling (OR 0.56, CI 0.43–0.72) are associated with less positive responses,