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Public opinion on global distribution of COVID-19 vaccines: Evidence from two nationally representative surveys in Germany and the United States

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ABSTRACT

Despite ongoing calls for a more even global distribution of COVID-19 vaccines, there remains a great disparity between high- and low-income countries. We conducted representative surveys among the adult populations in the United States (N = 1,000) and Germany (N = 1,003) in June 2021 to assess public opinion in these countries on the distributive justice of COVID-19 vaccines. We conducted two instances of analytic hierarchy processes (AHP) to elicit how the public weighs different principles and criteria for vaccine allocation. In further discrete choice experiments, respondents were asked to split a limited supply of vaccine doses between a hypothetical high-income and a hypothetical low-income country. AHP weights in the United States and Germany were 37.4% (37.2–37.5) and 49.4% (49.2–49.5) for "medical urgency", 32.7% (32.6–32.8) and 25.4% (25.2–25.5) for "equal access for all", 13.7% (13.6–13.8) and 13.3% (13.2–13.4) for "production contribution", and 16.3% (16.2–16.4) and 12.0% (11.9–12.1) for "free market rules", respectively, with 95% CI shown in parentheses. In the discrete choice experiment, respondents in the United States and Germany split available vaccine doses such that the low-income country, which was three times more populous than the high-income country, on average received 53.9% (95% CI: 52.6–55.1) and 57.5% (95% CI: 56.3–58.7) of available doses, respectively. When faced with a dilemma where a vulnerable family member was waiting for a vaccine, 20.7% (95% CI: 18.2–23.3) of respondents in the United States and 18.2% (95% CI: 15.8–20.6) in Germany reduced the amount they allocated to the low-income country sufficiently to secure a vaccine for their family member. Our results indicate that the public in the United States and Germany favours utilitarian and egalitarian distribution principles of vaccines for COVID-19 over libertarian or meritocratic principles. This implies that political decisions favouring higher levels of redistribution would be supported by public opinion in these two countries.

1. Introduction

For the first time in history, a vaccine was developed during a global pandemic. Vaccine production resources are scarce and do not match demand [1]. The situation regarding virus variants and possible booster shots due to declining vaccination protection over time make global (re-)distribution decisions between countries even more complicated [2]. These special circumstances bring about new questions regarding distributive justice and rationing of scarce COVID-19 vaccine doses on a global scale [3,4]. There are great disparities between countries across the globe with respect to access to COVID-19 vaccine doses. As of mid-October 2021, only 2.8% of people in low-income countries have received at least one dose of a COVID-19 vaccine [5]. Meanwhile and by the same date, 65.2% of people in the United States and 68.3% in Germany have received at least one dose of the vaccine and both countries have secured a vaccine supply that would suffice 337% and 242% of their population, respectively [6]. The emergence of new variants shows that people in high-income countries (HICs) are not safe even if fully vaccinated, unless actions are taken globally [7]. Despite several calls for equity in the global distribution of vaccines [8,9], the COVID-19 Vaccine Global Access programme

Abbreviations: AHP, Analytical hierarchy process; COVAX, The COVID-19 Vaccine Global Access programme; GDP, Gross domestic product; HICs, High-income countries; ICU, Intensive care unit; LMICs, Low- and middle-income countries; OR, Odds ratio; R&D, Research and development; SD, Social desirability.

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(COVAX) remains far behind its target [10]. The reluctance of countries who could afford to share more vaccines might be due to the unpredictable nature of the pandemic, but in addition, it could reflect political concerns about public disagreement. This raises the question that which distribution principles are favoured by the populations in the HICs that have ample access to vaccines: (i) distributing the vaccines according to greater outcome (utilitarian), (ii) equality for all (egalitarian), (iii) merits based on research and development (R&D) or vaccine production efforts [11], or the present status quo, (iv) based on free market principles [12]? In this line of thought, our study investigates which of these grounds are supported by the populations in the United States and Germany as the leading countries in the R&D of COVID-19 vaccines. Moreover, these countries were particularly selected because they have the capacity to share COVID-19 vaccines with LMICs. Early studies conducted in the United States in July 2020 [13] and in Nov. - Dec. 2020 [14], respectively, found that 39.6% and 22% of respondents were willing to donate more than 10% of the country's vaccine supply to the WHO for distribution across those countries that have insufficient resources to buy their own. However, this was before a devastating winter wave, with a large number of daily deaths in the United States and Germany being reported in Jan. - Feb. 2021 [15]. Furthermore, it is plausible that when it comes to one's own or a loved one's life, people change their level of generosity in terms of sharing a lifesaving resource, as opposed to when there is no clear case of self-interest [16,17].

2. Material and methods

The study instrument consisted of four main modules (Appendix A, Section II). In the first module, respondents were asked through the Analytical Hierarchy Process (AHP) which ground they believed to be more important for the fair distribution of COVID-19 vaccines across the world. These grounds were "equal access for all", "medical urgency", "free market rules apply", and "production contribution", representing egalitarian, utilitarian, libertarian, and meritocratic values, respectively. Respondents were presented with combinations of each pair in random order.

The second module was a discrete choice experiment asking respondents to divide a hypothetical 100 million doses of vaccines between countries A and B. These two countries resembled a high- and low-income country; e.g. country B had 300 million inhabitants, 3,000 COVID-19 deaths per day, and ordered 100 million vaccine doses while country A had 100 million inhabitants, 200 COVID-19 deaths per day, and ordered 1,000 million vaccine doses (Appendix A, Section II, questions 6–8). At first, the task statement was general and did not have any reference to the respondents. Then, respondents were asked to think of a vulnerable family member being on the waiting list in country A with the information that this person's place on the waiting list was equal to the amount allocated to country A in the previous scenario plus 10 million. This meant that for this person to receive the vaccine, the respondent had to reduce the amount given to country B by at least 10 million. In the third scenario, respondents were asked to play the same allocation game but this time, consider themselves to be on the waiting list in a place where they needed to add 30 million additional doses to the amount given to country A to be vaccinated themselves. These changes in scenario added an element of self-interest at a time when many respondents were still waiting for their first dose of the vaccine.

In the third module, respondents were asked for their level of agreement (on a 7-point Likert-type scale, 1 = *strongly disagree* to 7 = *strongly agree*) to wait for their own vaccine for three months so that people in countries with specific characteristics could be vaccinated earlier. These characteristics were a larger population, a higher number of COVID-19 deaths, a lower number of intensive care hospital beds, a higher number of vaccine pre-orders, a higher annual income per head, investment in R&D of the vaccines, and production capacity for vaccines.

The fourth module was a second AHP asking respondents to rate the importance of seven criteria for vaccine distribution: "number of inhabitants", "number of daily COVID-19 deaths", "number of intensive care unit (ICU) beds per 100 k population", "number of vaccines pre-ordered", "annual income per head (GDP)", "investment in vaccine research and development (R&D)", and "vaccine production capacity". Respondents were presented with combinations of each pair in random order.

To control for potential biases, respondents were asked whether or not they had already been vaccinated, to what extent COVID-19 had a negative impact on their lives (7-point Likert-type scale, 1 = *strongly disagree* to 7 = *strongly agree*), and also their tendency for social desirability bias using the short 5-item version of the Marlowe-Crowne scale (SD5) [18]. For the discrete choice experiment, we used a simple logistic regression model to investigate associations between respondents' characteristics and their decision to reduce the amount allocated to the low-income country when facing a scenario with a clear self-interest.

A minimum sample size of 1,000 was set following the method used by Gallup for conducting national polls [19]. Using quotas, the sample was drawn to be representative of the adult population (aged 18 and older) in the United States and Germany, according to age, gender, education, and state. Quotas were also placed for the vaccination rate to be representative of the general public at the time of the fieldwork, from 25 May 2021 to 26 June 2021. Participants were recruited by a professional survey agency (INFO located in Berlin). The recruitment process was conducted online in the United States. In Germany, to achieve a representation of older age groups, half of the recruitment attempts were made via phone calls. All of the respondents completed an online version of the questionnaire, which was translated into German. We conducted multiple pilots to ensure survey clarity prior to its launch. All respondents gave their consent prior to participation. After the completion of the survey, AHP data that were clearly unreliable (respondents selected the same response options, e.g., the first one, for all the possible comparisons) or inconsistent (AHP inconsistency index indicating randomness) were removed from the dataset. AHP weighting was calculated by using the dashboard Expert Choice Comparion and Stata 14.2 was used for the statistical analyses.

3. Results

Overall, 1,000 responses in the United States and 1,003 in Germany were collected (for respondents' demographics, see Appendix A, Table A1). In the first AHP model, "medical urgency" received 37.4% (95% CI: 37.2–37.5), and 49.4% (95% CI: 49.2–49.5) of the United States and German participants weighting across the four principles, respectively. This was followed by "equal access for all" receiving 32.7% (95% CI: 32.6–32.8) of the United States and 25.4% (95% CI: 25.2–25.5) of the German respondents' overall weighting. "Production contribution" received 13.7% (95% CI: 13.6–13.8) and 13.3% (95% CI: 13.2–13.4) and "free market rules apply" received 16.3% (95% CI: 16.2–16.4) and 12.0% (95% CI: 11.9–12.1) weighting in the United States and Germany, respectively. Respondents who gave the highest weight to a certain criterion did not systematically differ from respondents who gave the highest weight to another criterion by age, gender, education level or employment status (see Appendix A, Table A2).

In the second AHP (the fourth module of the survey instrument), we replaced the general principles from the first AHP with

seven concrete criteria as their proxies. Respondents in the United States and Germany gave the following weightings to each criterion: "number of inhabitants" 14.4% (95% CI: 14.4–14.5) and 12.9% (95% CI: 12.8–12.9), "number of daily COVID-19 deaths" 28.7% (95% CI: 28.6–28.8) and 32% (95% CI: 31.9–32.1), "number of intensive care hospital beds (per 100,000)" 18.6% (95% CI: 18.5–18.6) and 23% (95% CI: 22.9–23), "number of vaccines preordered" 10.4% (95% CI: 10.3–10.4) and 9.3% (95% CI: 9.3–9.4), "annual income per head (GDP)" 5.2% (95% CI: 5.2–5.2) and 4.4% (95% CI: 4.4–4.4), "invested in vaccine research and development" 10.8% (95% CI: 10.7–10.8) and 8.9% (95% CI: 8.8–8.9), and "vaccine production capacity" 11.9% (95% CI: 11.9–12) and 9.5% (95% CI: 9.5–9.6). Fig. 1 presents how the first and second AHP results compare with each other.

In the experiment during which participants were asked to divide 100 million doses of vaccines between countries A and B, in a general scenario when there was no clear self-interest, on average, respondents in the United States gave 53.9 million (95% CI: 52.6–55.1) and in Germany 57.5 million (95% CI: 56.3–58.7) of available doses to country B, which had three times as many inhabitants as country A. We asked respondents at this point (and also in the following scenarios) to elaborate on the reason behind their decision in a free-text comment. These comments covered a wide range of reasoning, including some who found a half-half distribution to be a fair divide. While such a divide is not considerate of the population size difference between these two countries, this was not a major issue, as the intention of this experiment was to find the pattern of change when a clear self-interest bias was added to this general scenario. When participants were faced with a situation wherein one of their vulnerable family members was on the waiting list, 20.7% (95% CI: 18.2–23.3) of respondents in the United States and 18.2% (95% CI: 15.8–20.6)

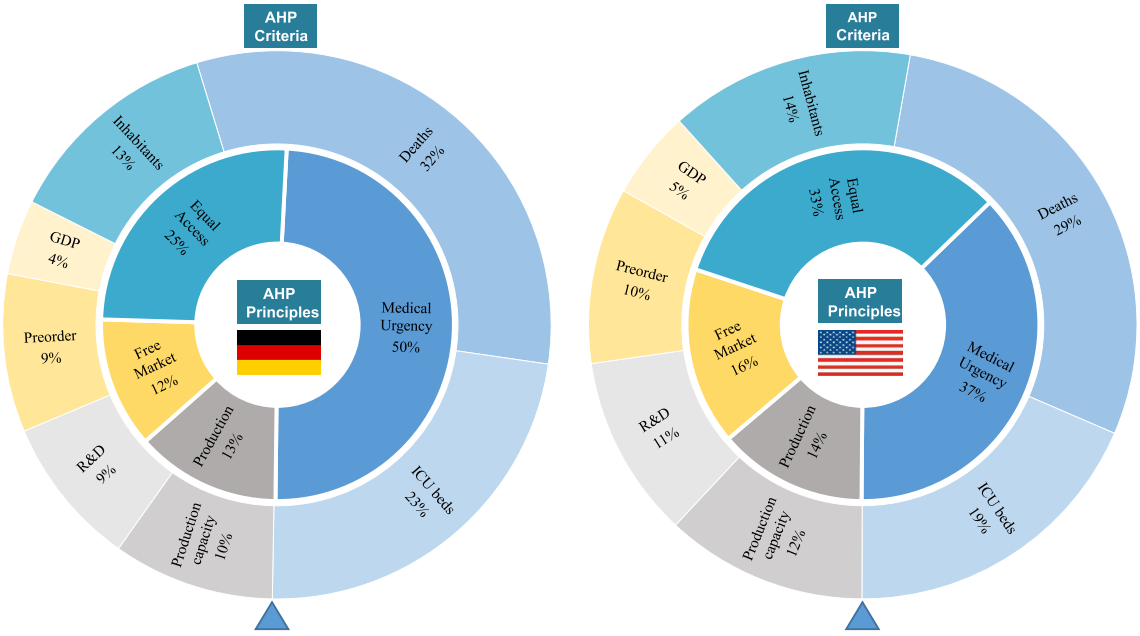

Fig. 1. Weighting of four principles (inner circle) versus seven criteria (outer circle).

Table 1
Odds ratio (*OR*) of reducing the amount given to country B enough to have sufficient supply for a vulnerable family member or the respondents themselves.

	Vulnerable family member		Oneself	
	US	DE	US	DE
	(1) *OR*	(2) *OR*	(3) *OR*	(4) *OR*
Age group >= 70	1.49	1.81**	1.41	1.66
	(0.93–2.38)	(1.08–3.02)	(0.69–2.89)	(0.79–3.48)
Female = 1	0.99	1.15	0.70	1.81
	(0.71–1.39)	(0.79–1.66)	(0.40–1.23)	(0.94–3.47)
Education: US: bachelor or higher / DE: Abitur or technical diploma = 1	0.99	1.26	0.78	0.65
	(0.68–1.44)	(0.86–1.85)	(0.41–1.45)	(0.32–1.29)
Employment: employed (any type) = 1	0.91	0.76	0.89	0.94
	(0.63–1.32)	(0.48–1.20)	(0.49–1.61)	(0.46–1.95)
Been vaccinated = 1	1.28	0.85	1.32	1.49
	(0.88–1.86)	(0.57–1.26)	(0.73–2.38)	(0.76–2.95)
SD5	1.00	1.00	1.00	1.02**
	(0.99–1.00)	(0.99–1.01)	(0.99–1.01)	(1.00–1.03)
Life affected by COVID-19	0.97	1.02	1.03	1.06
	(0.88–1.06)	(0.93–1.13)	(0.89–1.21)	(0.90–1.24)
Constant	0.27***	0.19***	0.07***	0.02***
	(0.16–0.44)	(0.10–0.36)	(0.03–0.15)	(0.01–0.06)
Observations	1,000	1,003	1,000	1,003

Robust CI (eform) in parentheses; *** p < 0.01, ** p < 0.05. Age equal to or greater than 70 = 1, otherwise 0; education level in the United States (US) as "bachelor degree or higher" = 1 and in Germany (DE), "abitur / technical diploma" = 1, otherwise 0; employment status as "employed (any type)" = 1, otherwise 0.

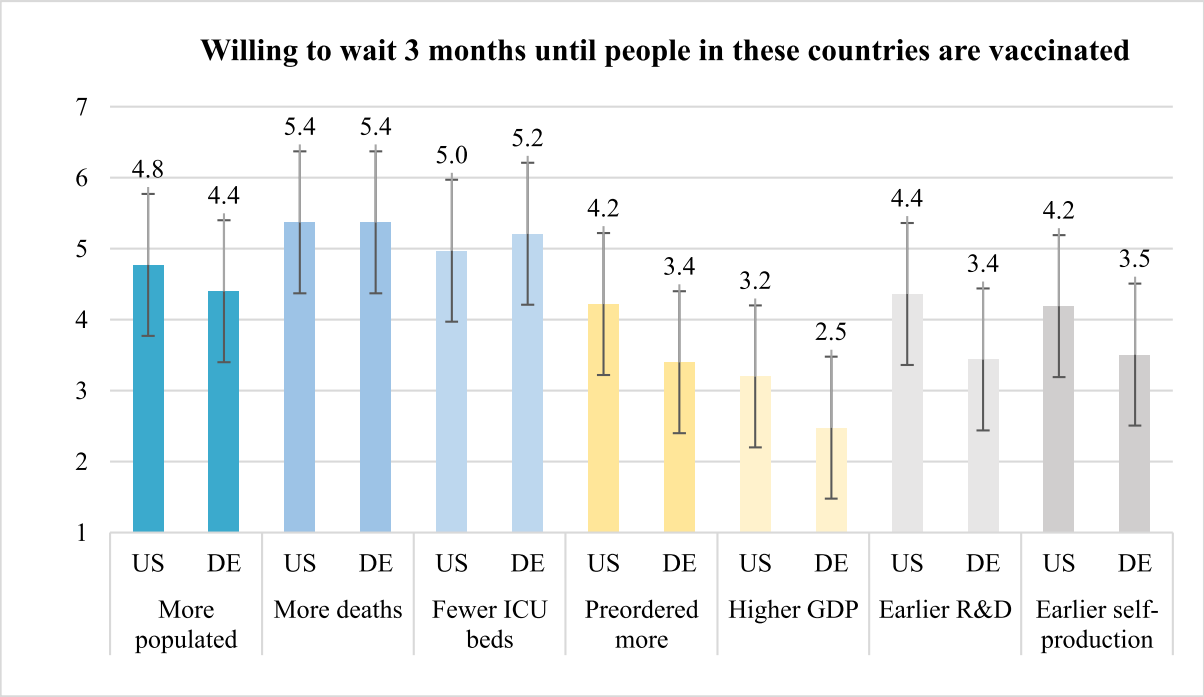

Fig. 2. Mean level of willingness to wait on a 7-point scale (1 = *strongly disagree* – 7 = *strongly agree*).

in Germany reduced the amount they had given to country B by at least 10 million doses (the minimum amount needed to be added to the share of country A so that their family member could receive a vaccine). In the third scenario, when they were asked what if they themselves were on the waiting list, 6.9% (95% CI: 5.3–8.5) of respondents in the United States and 5.7% (95% CI: 4.3–7.2) in Germany reduced the amount allocated to country B by at least 30 million doses (the minimum amount they needed to add for country A allocation so that they themselves would receive a vaccine as opposed to when the scenario was rather general).

Table 1 presents the results of a logit regression with a binary variable as an outcome that a respondent reduced the amount allocated to country B by enough to have sufficient supply for a vulnerable family member or the respondents themselves. We do not find a significant association of this decision with gender, education level, employment status, vaccination status or previous exposure to COVID-19. However, there was an association with an age of 70 and above, which was statistically significant for the scenario with a vulnerable family member in Germany.

Fig. 2 illustrates the extent to which respondents were willing to wait three more months for their own vaccine so that people in countries with certain characteristics could receive it earlier (7-point scale, 1 = *strongly disagree* to 7 = *strongly agree*). This question was particularly critical during the time of the survey (June 2021), as many respondents were still waiting to be vaccinated themselves. In both the United States and Germany, the highest level of agreement was with waiting so that people in countries with a higher number of COVID-19 deaths followed by those with fewer ICU beds could be vaccinated earlier.

We triangulated the results from this scale-item module with the second AHP, as both cover similar criteria; hence, like-to-like comparisons could be made. The results indicate close relationships between the characteristics of the country for which respondents were more willing to wait and the criterion that they gave the highest weighting in the second AHP. This in turn indicates that participants' responses to these different sets of questions were highly consistent (see Appendix A, Tables A3 and A4).

4. Discussion

Our study measured public attitude towards the global distribution of COVID-19 vaccines. Using an analytical hierarchy process, we asked respondents to weigh various principles that could guide the distribution of COVID-19 vaccines across the world. We found that the general public in both the United States and Germany gave the highest weighting to principles that correspond with utilitarian values, followed by egalitarian values. Despite both countries being pioneers in the R&D of vaccines as well as having their own production capacities, the public in neither of these countries gave a high weighting to principles that correspond with merit-based considerations. As it stands, however, access to vaccines is ruled by free market principles, which in this study was given the lowest weighting. Overall, our results indicate that the public would prefer an equitable distribution of vaccines or a need-based approach.

In a discrete choice experiment, we asked respondents to divide scarce vaccination resources between a high- and a low-income country. When the scenario was altered such that a vulnerable family member or the respondents themselves were affected by this decision, only a relatively small share of respondents reduced the amount given to the other country by enough to ensure sufficient supply for their vulnerable family member or themselves. The decision to reduce the amount given to the low-income country was not correlated with the respondents' gender, education level, employment status, vaccination status or perceived past negative effects of COVID-19 on their lives. Additionally, there was only a weak correlation with old age. Based on the Marlowe-Crowne scale, we did not find that any of the results were driven by social desirability bias. However, our study has the limitation of reporting a cross-sectional observation of a dynamic and rapidly changing topic. In particular, public generosity could have been influenced by how optimistic they felt at each point in time depending on the current state of news they received, especially during the time of interviews, from May to June 2021. We also acknowledge that the survey covers an ethically challenging dilemma and also could be found cognitively heavy for some participants.

The presented results connect strongly to current discussions initiated, among others, by multilateral organisations like the IMF, the World Bank and the WHO. For example, as presented in the World Economic Outlook, global post-pandemic economic recovery hinges very strongly on vaccine distribution issues; the current distribution imbalances are forecasted to trigger severe economic imbalances in the future [20]. From a public health angle, the WHO is raising attention towards growing disparities as HICs proceed towards third and fourth booster vaccine shots, whereas many LMICs are still struggling to access and distribute first and second COVID-19 vaccine doses ([21], p. 63). It was with the aim of avoiding such disparity that COVAX was originally launched. However, in practice, this programme turned from a global procurement initiative into an aid for LMICs waiting at the end of the procurement queue and remained highly dependent on the HICs acts of generosity. Within the wide range of factors that prevented COVAX from reaching its target was the fear of political backlash [22]. Undoubtedly, protecting one's own citizens is a legitimate act. However, as the experience of the present pandemic has shown, hoarding vital resources is both unethical and can leave the world as a whole vulnerable to a highly infectious disease and its mutating virus [23]. Public perceptions regarding distribution of COVID-19 vaccine doses that we report in this study are very much in line with this view of humanity as one population, which is both an expression of fairness and arguably the best way out of the pandemic. Unfortunately, we are now in a situation where there are more vaccine doses available than people willing to be vaccinated in HICs and the opposite in LMICs [24], which is both short-sighted and against the preferences of the general public. For the policy environment in HICs, it has to be noted that although merit-based positions might be more visible throughout public debate and media coverage, public opinion leans more towards egalitarian and need-based principles. Aligning public action in HICs with these public perceptions might go a long way in overcoming the COVID-19 pandemic and valuing the views of the people at the same time.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethics Committee Approval

This study received ethical approval from the ethics committee at the University of Göttingen, Germany.

Patient and Public Involvement

Not applicable.

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Appendix A. Supplementary data

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