Public opinion in vaccine allocation priority: who comes first?

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Abstract

Objective: We investigated people's preferences in COVID-19 vaccine allocation priority, comparing different social categories based on age and occupation. Vaccine allocation preferences were related to perceived health vulnerability and economic backlash (economic negative consequences) endured by the different social groups during the pandemic. In-group favoritism in vaccine allocation preferences was analyzed.

Design: Data were collected through an online survey in Italy (n = 506) before the start of the vaccination campaign.

Main outcome measures: Vaccine allocation preferences, health vulnerability, and economic backlash due to COVID-19, measured through ranking tasks.

Results: The healthcare workers category was placed at the top of the ranking in vaccine allocation priority by 65% of the respondents. Vaccine allocation priority was related to perceived health vulnerability and not economic difficulties. Limited self-preference effects emerged. People who did not consider healthcare workers a priority (1/5 of the sample) had a lower education level, were more worried about COVID-19 infection risk, and did not trust vaccines.

Conclusions: A consensus emerged on who should be vaccinated first. Governments and policymakers should be aware of these preferences when designing and communicating vaccine allocation plans to predict and foster the public's acceptance of the COVID-19 vaccination programs created by experts.

Keywords: social ranking, vaccine distribution, age groups, economic status, health vulnerability

Word count: 7800

Introduction

The pandemic due to SARS-CoV-2 spread had an unprecedented impact on people's lives and on society as a whole (Bratianu, 2020; Bueno-Notivol et al., 2021; Cannito et al., 2020; Ceccato et al., 2021; Fontanesi et al., 2020; Roma et al., 2020; Salari et al., 2020; Santabárbara et al., 2021). The formulation of effective vaccines for COVID-19 marked a turning point in the management of the pandemic. Across the world, the vaccines' allocation is currently in progress, and different social groups have been identified to have priority by national and international health agencies (Hopkins Center for Health Security, 2020; World Health Organization, 2020; Yang et al., 2021). Setting priority groups and optimizing the limited available vaccine supply is crucial for managing the pandemic (Buckwalter & Peterson, 2020; Clarke et al., 2021). While many different vaccine candidates are currently undergoing clinical trials, the global production capacity cannot provide a COVID-19 vaccine for everyone (Khamsi, 2020; Wouters et al., 2021). Therefore, available supplies should be carefully allocated to maximize their potential to reduce the pandemic's death toll and transmission.

When this study was conducted (December 2020), several recommendations for the allocation of the COVID-19 vaccine were proposed across the world. The American Center for Disease Control and Prevention (CDC) suggested that healthcare personnel and long-term care facility residents should be vaccinated in the very first phase of vaccine distribution, forthwith followed by essential frontline workers and persons aged ≥75 years (Dooling et al., 2020). The European Centre for Disease Prevention and Control (ECDC) indicated that healthcare and persons over 60 years of age should get early access to the vaccines. Other groups who were considered for prioritization were: individuals whose health conditions make them particularly at risk, essential workers, people who cannot control social distance, and more disadvantaged socio-economic groups (European Commission, 2020). Similar

indications came from the World Health Organization (World Health Organization, 2020). Currently, while scientific evidence is growing, priorities are under reassessment, and allocation strategies are partly changing to include previously neglected populations, such as people with mental illness (De Picker et al., 2021). In the initial phases of the vaccination campaign (i.e., when the current study was conducted), international agencies and governments consistently identified occupation and age as the two main criteria for delineating vaccine allocation plans.

Public perception of vaccine allocation priorities may differ from the frameworks and programs proposed by experts and governments. People's opinions are relevant as they can inform policymakers about public consent and consequent compliance with vaccine uptake campaigns (Duch et al., 2021; Reeskens et al., 2021). Indeed, discrepancies between public preferences and official decisions may reduce people's trust in the government and consequently reduce the population's willingness to vaccinate (Sprengholz et al., 2021). Engaging the community is thus crucial for implementing a successful vaccination program (Gupta & Morain, 2021). Notably, a recent study revealed that being "overlooked" by the vaccine allocation plan and thus, waiting before receiving the vaccine, can reduce the willingness to vaccinate, even if a person previously desired the vaccine (Bruine de Bruin et al., 2021). Hence, clear communication of the reasons behind the vaccine allocation strategy is pivotal.

On the one side, the general population's opinions about vaccine allocation priority are likely linked to the perceived health vulnerability of some social categories, such as older adults and people with complex comorbidities. To prioritize these populations would reduce the risk of severe/fatal outcomes, protecting the frailest individuals. Other social groups, such as children, may be perceived as less at risk of contagion and death or generally less impacted

by the disease. Therefore, such categories could be considered as less urgent to be targeted by vaccination programs.

On the other side, COVID-19 impacted not only health but also the economy. Growing research indicates that the pandemic has had detrimental effects on the economy, both at the macro and the micro-level (Di Crosta et al., 2020, 2021; Ellul et al., 2020; Nicola et al., 2020). The unemployment rate is rising, especially for women and younger population (ILO - International Labour Organization, 2021; Tucci, 2021), and a broad segment of the population is waiting to know whether, when, and how they would be able to come back to work. Furthermore, for some people it might be more urgent to recover from the economic backlash (negative consequences of the COVID-19 pandemic on individuals' economic conditions) rather than manage the health crisis. Hence vaccine allocation priorities may be driven by economic considerations. Supporting this idea, Duch and colleagues found that "the public would also prioritize according to what might be deemed more economical factors, including low-income groups" (Duch et al., 2021, p. 5).

Finally, individual differences in preferences for vaccine allocation priority are likely related to a range of external factors, such as the general attitude toward vaccination, the direct experience of the COVID-19 disease, and membership to a specific social category.

Based on these reflections, the present study aimed to explore people's attitudes toward the vaccine allocation priority in Italy, examining ranking preferences for different social categories. For selecting social categories, we used the two most agreed criteria: age and occupation. Hence, we asked participants to rank different age groups (e.g., children, older adults) and different jobs/employments (e.g., healthcare workers, retailers) to prioritize receiving the vaccine. First, we inspected the age-based and job-based criteria separately. Then, we asked participants to rank by both, age-based and job-based social categories, to examine how opinions change when both criteria need to be considered together.

As anticipated, we hypothesized that people could use two criteria to build the preferred vaccine distribution order: health vulnerability and economic backlash. On one hand, the vaccine may be considered more urgent for those social groups with a higher risk of death, who deserve more the protection offered by the vaccination. Another possibility is that groups who suffered the economic consequences of the pandemic (e.g., lost their jobs or received reduced wages) could be perceived as more in need of the vaccine to safely return to work and help restart the economy. To test this speculation, we asked participants to rank the social categories also in terms of the negative effects of the pandemic on both health and finances. These rankings were correlated to the vaccine allocation priority to examine if the social categories that were perceived as the most impacted by COVID-19 (either in terms of health or of economic status) were also those considered to deserve the vaccine the most.

Furthermore, we examined potential self-preference attitudes: the presence of in-group favoritism is widely acknowledged and impacts a range of behavior (Fu et al., 2012; Tajfel et al., 1971). According to the social identity theory (Hogg, 2020), human tendency for group aggregation has several evolutionary advantages: to belong to a specific group (and identifying an out-group) boosts self-esteem, facilitates information and resources sharing, and guides behaviors (Guassi Moreira et al., 2017). Especially when mortality is salient, such as during the current pandemic, the sense of membership to a social group is strengthened, and in-group favoritism becomes more widespread (Han et al., 2021; Li et al., 2015). Henceforth, we supposed that people's membership to a given social category might favor such a group when ranking vaccine distribution, giving it a higher priority. We examined self-preference effects also in health vulnerability and economic backlash rankings. Such effects would indicate possible overestimations of the negative effects of the pandemic on the social category to which individuals belong.

Finally, we explored unusual vaccine allocation priority, focusing analyses on those (few) people who did not consider healthcare workers as one of the most urgent categories to be vaccinated. We inspected which factors characterize these individuals, if any, by considering demographic, COVID-related, and psychological variables.

Materials and methods

Participants

The sample was composed of 506 Italian adults from 18 to 96 years old (M = 37.40, SD = 21.65, women = 72%). More details on demographic variables are provided in Supplemental materials, Table S1. Participants were recruited among the undergraduate students of the "G. d'Annunzio" University of Chieti-Pescara. Students who participated were requested to share the link of the survey with their contacts through word-of-mouth and social networks. As the study was conducted through an online survey, participants were a convenience sample selected based on their accessibility to the survey. The Ethical Committee of the Department of Psychological, Health and Territorial Sciences, "G. d'Annunzio" University of Chieti-Pescara (protocol number: 20004) approved the study. All participants had to confirm their consent to participate for the survey to start.

Procedure and measures

Data were collected through an anonymous online survey implemented in the Qualtrics platform between December 16th, 2020, and January 15th, 2021. During that period, vaccine distribution was about to start in Italy. Therefore, the topic was widely discussed among the general population. The survey was 20-minute long and comprised three ranking tasks followed by questions about participants' experience with the COVID-19 disease and a questionnaire on COVID-related fear. We also measured general attitudes toward vaccines and collected demographic information.

Ranking tasks

Three ranking tasks were presented: vaccine allocation, health vulnerability, and economic backlash. The health vulnerability and the economic backlash rankings' order of presentation were counterbalanced. The vaccine allocation ranking was always the last task. However, when presenting the results, we reported the data on the ranking of the vaccine allocation first since it was the outcome of major interest. The three ranking tasks were similar in structure. People were administered three trials[1] , and in each of those, they were asked to rank different social categories (see table 1 and figure 1 for the exact categories included). The three trials were: age-based categories, job-based categories, and aggregate categories (which comprised all the previously presented categories). Age-based and job-based trials were presented in counterbalanced order, always followed by the aggregate trial. In the vaccine allocation ranking, participants were asked to imagine that an effective vaccine was available. They had to decide how to allocate it by creating a priority ranking of the social categories presented. Similar instructions were provided for the health vulnerability ranking task (i.e., "In your opinion, on which of the following age groups/job groups/categories the COVID-19 has had the most severe impact, in terms of health?"), and for the economic backlash ranking task (i.e., "In your opinion, on which of the following age groups/job groups/categories COVID-19 has had the most severe impact, in terms of negative economic consequences?") (see the Supplemental materials for complete instructions).

Fear of COVID-19

[1] Only in the vaccine allocation priority ranking task, there was an additional, preliminary trial. In this first trial, participants were asked which category they would prioritize choosing between age and job. People equally selected both categories (age: 50.4%; job: 49.6%), $\chi^2(1) = 0.07$, $p = .799$), suggesting that this categorization was not sufficient to guide the decision. Given the limited informativeness of this result, we did not analyze this trial any further.

This questionnaire, explicitly created for the COVID-19 emergency, consisted of eight items, referring to either self or loved ones' health (Ceccato et al., 2020; Di Crosta et al., 2020). The questionnaire comprises two scales: Belief of contagion (BC), reflecting the conviction of being infected, either in the past or in the future, and Consequences of contagion (CC), reflecting the possibility of suffering severe consequences due to the contagion (i.e., to be hospitalized or to die). Participants answered on a scale from 0 (not at all) to 100 (extremely). Two scores ranging from 0 to 100 were computed by averaging the items in each scale. Internal reliability was satisfactory, Cronbach's $\alpha = .77$ for the BC scale, and Cronbach's $\alpha = .81$ for the CC scale.

Demographic and other information

Along with general demographic information, such as age, gender, education level, and job/employment status, we asked participants if they were, or have previously, tested positive to COVID-19. We also asked if someone close to them was, or has previously, tested positive to COVID-19. Responses were given in a yes/no format. We recoded these answers in a new variable, "Experience with COVID-19," by scoring 0 if a participant reported no positivity, neither for themselves nor for a close one. Otherwise, we scored 1. Finally, we examined participants' general attitudes toward vaccines. Specifically, we used the following item: "How effective, do you believe, are the vaccines for other diseases (such as rubella and tetanus)?". Responses were given on a scale from 1 (not at all) to 7 (completely).

Analyses plan

All analyses were conducted using SPSS 27.0 software (IBM Corp. Released, 2020). First, we analyzed vaccine allocation priority by examining the three trials of the vaccine allocation ranking task. We analyzed social categories in the following order: age-based, job-based, and aggregated (both age- and job-based categories). For each ranking, we examined: a) the homogeneity among raters, using Kendall's coefficient of concordance (a measure of

relative agreement that expresses the commonality of judgments for n observers. The coefficient ranges from 0, no agreement, to 1, all observers agree; Kendall & Gibbons, 1990); b) the differences in frequency distributions, via pairwise comparisons (Bonferroni adjusted); c) self-preference effects.

Secondly, we examined the two hypothesized criteria that might have guided people's opinions about vaccine allocation priorities, namely health vulnerability and economic backlash. For both of these criteria, we separately examined the different social categorizations (age-based, job-based, and aggregated) and tested for possible self-preference effects.

Thirdly, we assessed the links between vaccine allocation priority, perceived health vulnerability, and economic backlash using Spearman's rank correlation analyses.

Finally, we examined which factors characterized people not selecting the healthcare workers as the category to be prioritized in receiving the vaccine. To this end, we performed a binary logistic regression analysis, predicting people belonging to the typical vaccine priority group (vs. to the atypical vaccine priority group). Predictors were entered in the following order: a) demographic characteristics (age, gender, and education level); b) experience with COVID-19; c) the BC scale, and d) the CC scale from the Fear of COVID-19 questionnaire; finally, e) general attitude toward vaccination.

Results

Vaccine allocation priority

Age-based trial

First, we examined the ranking of age-based categories. Participants showed a moderate agreement in their choices, Kendall's $W = .41$, $p < .001$. Figure 1.a reports the ranking frequencies for each category. Scores ranged from 1, representing the category at the bottom of the list (i.e., the category with the lower urgency to be vaccinated) to 7. Pairwise

comparisons between the seven frequency distributions indicated that they all differed from one another, but the distributions of the two older adults' groups ("65-84" and "85+" categories), and the distributions of children and adolescents ("2-11" and "11-18" categories), which were comparable (Supplemental materials, figure S1.a). Overall, the two older age groups were given higher priority. Most of the participants (62%) considered the "85+" category the first one to be vaccinated, and 64% of the sample indicated the "65-84" category as the second one. Infants ("0 -2") and children ("2-11") were identified as the less urgent categories to be vaccinated by about 60% of the population (Supplemental materials, table S2).

Then, we examined the self-preference effect, testing whether people differed in ranking their age category. To this end, we categorized participants into four age groups -the very same age-based categories presented in the ranking task. We compared the frequency in which each age group (e.g., young adults) rated its age-based category (e.g., "18-30") at the top of the ranking to the frequency in which all the other age groups (collapsed) rated that age-based category at the top of the ranking. Results revealed that no age group preferred its age-based category in the vaccine allocation ranking (table 1).

Job-based trial

When asked to rank job-based categories, people showed slightly lower agreement, Kendall's $W = .37$, $p < .001$ (figure S1.b). Crucially, however, the choice of the top-rated category was almost unanimous: about 85% of the participants indicated that "healthcare workers" should be vaccinated first (figure 1.b). Less consensus emerged on the other job-based categories. However, we noted that about 30% of the sample believed that "students" should be the last group to be vaccinated (Table S2 in Supplemental materials).

We, then, examined the potential self-preference effects based on the participants' jobs. Since only one participant identified himself as a public safety worker, we excluded this

category from the analysis. Also, we excluded participants with employments classified as "other" (see Table S1 on Supplemental materials for details). Hence, for this analysis, we focused on a subsample of 383 participants. We compared the frequency in which each occupation group rated its job-based category at the top of the ranking, and the frequency of all the other participants collapsed. Findings revealed that retired persons rated their category as the first to be vaccinated more often than the other participants did (table 1). Follow up analyses revealed that this preference reflected retired persons' lower frequency of selection of "healthcare workers" (76%) as the first category to be vaccinated, as compared to the frequency of the rest of the sample (88%), $\chi^2(1) = 7.61$, $p = .006$.

Aggregate trial

Finally, we inspected people rankings in the aggregate trial, where both age and job categories were presented together. Results are summarized in figure 1.c. Participants' agreement was lower than the previous rankings, Kendall's $W = .34$, $p < .001$. Comparing frequency distributions, results indicated that infants, children, and adolescents ("0-2", "2-11" and "11-18" categories) were similarly collocated at the bottom of the ranking (figure S1.c). "Healthcare workers" maintained the top position (65%), which was, to some extent, shared with the "85+" age group (22%). Therefore, between occupation and age, it emerged that the job-based category was prioritized by most of the participants.

Given a large number of available positions in the ranking (i.e., fourteen), in the follow-up analyses, we focused on the top-three positions ("high priority") and the bottom-three positions ("low priority"). "Healthcare workers" were considered as high priority to receive the vaccine by 81% of the sample, followed by older-old adults ("85+" category, 62%) and older adults ("65-84" category, 52%). This result confirmed the greater salience of the job criterion over the age criterion in vaccine allocation preferences. The categories at low

priority were minors, often collocated in the bottom-three positions ("0-2": 59%; "2-11": 57%; "11-18": 47%).

[Figure 1]

[Table 1]

Social categories' ranking as a function of health vulnerability

Age-based trial

The ranking for the age-based categories showed a linear trend from the older to the younger categories (figure 2.a). Participants were highly homogenous in their ratings, Kendall's $W = .69$, $p < .001$, and all the frequency distributions significantly differed from each other, ps $< .001$ (figure S2.a). Focusing on the top-rated category, 78% of the sample selected the "85+" category. Very few participants put children ("2-11") and adolescents ("11-18") at the top of the ranking (less than 5%). Indeed, minors were mostly collocated at the bottom of the ranking (table S3 in Supplemental materials).

Results for self-preference effects showed that younger adults put their age category on the top of the classification more frequently than the other age groups (table 2). This result indicates that younger adults overestimated the pandemic's effects on health for their age-based category. Notably, this preference reflected young adults' lower frequency of selection of the "85+" category at the top of the ranking (74.5%), compared to the other age groups' frequency (82.8%), $\chi^2(1) = 4.71$, $p = .030$.

Job-based trial

The ranking for the job-based categories showed a mixed pattern (figure 2.b), as reflected by the lower agreement between participants, Kendall's $W = .33$, $p < .001$ (figure S2.b). The top-rated job category was "healthcare workers" (69%), followed by "retired persons" (26%). Self-preference effects showed that retired persons collocated their category at the top of the ranking significantly more often than the other participants (table 2). This

self-preference reflected retired people's lower frequency of selection of the "healthcare professional" category at the top of the rank (50.60%), compared to the other job groups' frequency (69.67%), $\chi^2(1) = 10.44$, $p = .001$.

Aggregate trial

Finally, when participants had to rank age-and job-based categories collapsed, a moderate agreement emerged, Kendall's $W = .51$, $p < .001$ (see figure S2.c in Supplemental materials). The top position was most often attributed to the "85+" category (46%), followed by "healthcare workers" (38%) (Figure 2.c). Hence, age-based classification was preferred when choosing between two wide social categorizations (age and job).

Focusing on the top-three and bottom-three positions, we found that people over 85 (78.9%), the "65-84" group (71.1%), and "healthcare workers" (68.8%) were the three categories most often collocated in the upper positions. On the other side, the three categories perceived as less impacted in terms of health were minors (infants "0-2": 78%; children "2-11": 73%; adolescents "11-18": 49%). This result likely reflects people's knowledge about the COVID-19 epidemiological prevalence. Indeed, there was a widespread consensus among the media and the public opinion that minors infected by COVID-19 suffered limited negative health consequences.

In conclusion, people considered older adults and healthcare workers the categories more at risk in terms of consequences for health. Children and younger adults were perceived as less negatively impacted by the pandemic in terms of health vulnerability.

[Figure 2]

[Table 2]

Social categories' ranking as a function of economic backlash

Age-based trial

When asked to rank age groups in the function of the economic difficulties faced due to the pandemic, participants were moderately homogenous, Kendall's $W = .55$, $p < .001$ (figure 3.a). Pairwise comparisons of the frequency distributions indicated that all the age-based categories significantly differed, ps $< .001$, but the distributions of the "11-18" and the "65-84" categories (figure S3.a). That is, adolescents and older adults received similar positions in the ranking.

The "30-64" category was placed at the top of the ranking by 62% of the participants, indicating that people consider adults/middle-aged adults as the group more economically compromised by the pandemic. The 18-30 category was sometimes rated at the first position, 20%, but was mostly put at the second position, 54% (see Table S3 in Supplemental materials).

Regarding self-preference effects, we found that older adults ("65-84") put their age-based category on the top of the rating significantly more often than the other participants. Nevertheless, older adults' self-preference did not significantly reduce the frequency of selection of the "30-64" category at the top of the rank (53.9%), compared to the other age groups' frequency (63.4%), $\chi^2(1) = 2.86$, $p = .091$.

Job-based trial

The ranking based on the job category showed mixed results (figure 3.b), with participants showing relatively low agreement, Kendall's $W = .35$, $p < .001$. "Retired persons", "public safety workers", and "students" were ranked similarly (namely, in the lower positions of the ranking), while all the other categories significantly differed from each other. Quite predictably, "retailers" were rated as the most affected group, economically, by the COVID-19 pandemic by the majority of the sample (67%). Unexpectedly, a relatively high percentage of the participants (18%) put "healthcare workers" at the top of the ranking.

Focusing on self-preference effects, we found that retired people put their category at the top of the economic backlash ranking more often (6%) than the other participants (1%). However, retired participants put retailers at the top (63%) as often as the other participants (66%), $\chi^2(1) = 0.26$, $p = .610$. No other significant self-preference effects emerged (table 3).

Aggregate trial

Finally, when we asked participants to rank social categories collapsing age- and job-based categories, we found relatively low agreement among participants, Kendall's $W = .37$, $p < .001$ (figure S3.c). The first position was mostly attributed to "retailers" (about 55%), way more often than "healthcare workers" (12%) and the "30-64" category (10%), which followed (figure 3.c). Focusing on the top-three positions, "retailers" (77%), adults aged from 30 to 64 (57%), and "laborers" (51%) were considered the categories most negatively impacted by the pandemic in terms of economic effects. Not surprisingly, the categories mostly put at the bottom of the rankings were infants (59%) and children (57%).

[Figure 3]

[Table 3]

Vaccine allocation priority and perceived health vulnerability/economic backlash

For each social category presented in the aggregate trial (i.e., both age-based and job-based), we ran separate Spearman's rank correlation analyses between the vaccine allocation ranking and health vulnerability and economic backlash rankings. Results are summarized in table 4. Findings indicated that vaccine allocation ranking was associated with perceived health vulnerability for all the social categories. In other words, the groups perceived as less severely affected by COVID-19 were less prioritized in vaccine allocation and vice versa. Vaccine allocation was positively associated with the ranking of economic backlash only for infants, retired persons, and public safety workers.

Overall, we concluded that health issues drove people's opinions about vaccine allocation priority more than economic difficulties.

[Table 4]

Individual differences explaining vaccine allocation priority

As described above, people mostly identify healthcare workers as the social category that should be vaccinated first. This choice is in line with the suggestions from the WHO and with the decision of the Italian Government. However, 35% of the sample did not collocate this category in the top position. More strikingly, almost 20% of the sample did not even collocate healthcare workers in the top three positions. Hence, we explored which demographic and psychological factors may explain this difference. To this end, we created a new variable by dichotomizing participants into two groups: people who prioritized healthcare workers (HW group, n = 410) vs. people who did not (NHW group, n = 96). This variable was entered as an outcome in a logistic regression analysis. Predictors were entered in the following order: a) demographic characteristics (age, gender, and education level); b) experience with COVID-19; c) the BC scale, and d) the CC scale from the Fear of COVID-19 questionnaire; finally, e) general attitude toward vaccination. Results are presented in table 5. Descriptive information for the predictors is provided in the Supplemental material (table S4).

Findings revealed that education level, the BC scale, and general attitude toward vaccination were the predictors significantly discriminating between HW and NHW groups. Specifically, people with lower education levels, with higher fear of being infected, and with lower trust in the vaccines' efficacy were more likely to not prioritize healthcare workers.

[Table 5]

Discussion

The distribution of COVID-19 vaccines across the world is following priority guidelines. Based on different theoretical frameworks, vaccine allocation programs have adopted two main criteria: individuals' age and employment (Duch et al., 2021). These two criteria satisfy utilitarian and egalitarian principles, which have guided triage policies in past health emergencies (Buckwalter & Peterson, 2020). Crucially, the public opinion may not agree with the experts' allocation principles. However, gauging the public's view is crucial, as the vaccine uptake also depends on people's expectations and perception of a fair and equitable program for vaccine allocation (Eshun-Wilson et al., 2021; Gollust et al., 2020; Subbarao, 2020). In this study, we explored the opinion of the Italian population on vaccine prioritization by asking participants to rank social groups in terms of preferred order for vaccine allocation. In doing that, we also examined whether the vaccine allocation priority was driven by perceived health vulnerability or economic distress of the social groups. Crucially, our study started just before the beginning of the vaccination campaign in Italy, when government guidelines were still under assessment, and the general public was deliberating the topic.

To summarize our results, we found a wide consensus among the participants indicating healthcare workers and older people as the categories that should be prioritized. Perceived health vulnerability emerged as the driving factor behind this choice: the social categories considered more (less) negatively impacted by the pandemic were also given higher (lower) priority in the vaccine ranking. On the contrary, economic difficulties due to the COVID-19 pandemic were not considered a good criterion in defining vaccine allocation priority. Furthermore, we found that about 20% of the sample did not prioritize healthcare workers, which is the category that should be vaccinated first according to international health agencies and the general public. These individuals were characterized by lower education

levels, higher fear of being infected by SARS-CoV-2, and less trust in vaccination. Below is a detailed discussion of these findings.

The main result of this study is that people in Italy recognize healthcare workers as the group with the highest priority to receive the vaccine. Similar results emerged in a range of studies across the world (Bruine de Bruin et al., 2021; Duch et al., 2021; Gollust et al., 2020; Persad et al., 2021; Reeskens et al., 2021). From a theoretical point of view, prioritizing healthcare workers satisfies both the egalitarian (as they are more at risk) and the utilitarian (as they are essential for managing the pandemic) principles (Zimmerman et al., 2020). From a practical point of view, the fact that the general public's views are similar to the official policies is promising, as it may lead to a higher level of acceptance and compliance during the actual vaccine distribution phase (Braunack-Mayer et al., 2010; Dal-Ré & Camps, 2021). Regarding the age criterion, our results contrasted previous findings. Reeskens and colleagues (2021) found that middle-aged adults, but not older adults, were prioritized over younger adults (see also Luyten et al., 2020). Furthermore, children were prioritized over middle-aged adults in an American sample (Gollust et al., 2020). Also, Sprengholz and colleagues (2021) found that the "age-related vulnerability alone does not seem to be sufficient for prioritization". However, in support of our findings, a wide cross-country study indicated that, across the world, greater ages (over 65) were generally prioritized compared to younger ages (25 and 40 years) (Duch et al., 2021).

Overall, our data suggested that the general public's views are remarkably homogeneous regarding the vaccine priorities, especially for the first and the last social categories. The concordance across different social groups, and the limited role played by other sources of individual variability reveal the presence of a broad societal consensus on such an important topic.

Based on the social identity theory (Hogg, 2020), we also hypothesized that, in ranking social categories, people might be inclined to prioritize those social groups to which they belong. Hence, we searched for potential judgment bias toward social groups by comparing the first position attribution across social categories. For vaccine allocation priorities, we found that, out of fourteen social categories, only retired people tended to put their category most often at the top of the ranking compared to the participants in the other job-based categories. Hence, retired persons felt the urgency to be vaccinated (Gollust et al., 2020). However, besides this effect, people did not show marked self-preference effects in vaccine allocation priority, as suggested by previous research (Duch et al., 2021). This is an encouraging result, as it could indicate that the risk of witnessing a race to receive the vaccine is limited.

A secondary goal was to determine which criterion guides people's views on vaccine distribution order, inspecting people's opinions on health and economic backlash suffered by different social groups. For health vulnerability, we found that older people (in the age-based classification) and healthcare workers (in the job-based classification) were the categories considered as more damaged. This pattern did not change when both age and job categories were collapsed. This is not surprising, as official sources provide daily information on the COVID-19 severity and mortality through media, and people's opinions seem to reflect objective data. For the economic backlash, results indicated that people of working age (in the age-based classification), retailers, and laborers (in the job-based classification) were identified as the categories enduring greater economic difficulties. The pattern was the same in the collapsed classification. This result has practical implications, as it can inform policymakers on people's attitudes toward recovery funding policies. As retailers and laborers were perceived as the most impacted, these categories could be considered the first to benefit from economic support.

Regarding self-preference effects, we consistently found that retired persons tended to put their category most often at the top of health vulnerability and economic backlash rankings compared to other participants. Hence, this social group maintained a more negative view of its health and economic situation than participants in the other social categories (Rosi et al., 2021). This result could be due to an overestimation by older adults of their health/economic situation. Still, it may also indicate an underestimation by other social groups of older adults' actual difficulties and needs. We also found that young adults (18-30 years) showed a bias for their category in the health vulnerability ranking. On a speculative note, it may be that people aged 18-30 have a negative picture of the health burden paid by their age group, while other age groups may believe that younger adults are "safe" from health consequences. Our data cannot discriminate among these possibilities but suggested that different social groups have different views on the COVID-19 consequences on their lives.

For the association between vaccine allocation and negative health/economic consequences, we found that perceived health vulnerability was steadily related to vaccine allocation preferences. In other words, the social groups that should be vaccinated first are those who undergo more severe health consequences (i.e., healthcare workers and older adults). Results for economic backlash were less consistent, and their interpretation is not straightforward. This result echoed the findings from a recent study, in which participants were requested to rate the importance of different vaccine allocation objectives. The authors found that "sustaining public life", and thus also the economy was considered less important than reducing the risk of deaths (Sprengholz et al., 2021).

Overall, given the inconsistency in the pattern and the small size of these effects, we concluded that economic issue is not the main factor in vaccine allocation preferences. Based on these findings, future developments of the vaccination campaign should consider the crucial role that perceived health vulnerability of a target population has on public perception

of a fair allocation of vaccines. In Italy, after the first phase of the vaccination campaign – which targeted healthcare workers and older adults living in residential care facilities – a second phase (starting from March 2021) included teachers and professionals in the educational sector as a priority. This choice was discussed – and contested – by the media and part of the population (e.g., Ainis, 2021). We reflected that the general idea of teachers being at little or moderate risk for health issues due to COVID-19 (as emerged by our ranking task) may have reduced the overall accord on this governmental choice.

Finally, we explored which individual factors explained the unusual choice to not select healthcare workers as a priority group for vaccine allocation. Healthcare professionals have been identified as the first group to be vaccinated by a range of health agencies and governments worldwide (e.g., World Health Organization, 2020). To not align with such a predictable choice is, at the very least, surprising – and even alarming. Our results indicated that about 20% of our sample preferred other social categories in the top three positions. Namely, people with lower education levels, more concerned about the risk of COVID-19 infection, and less trust in general vaccination programs were more likely not to prioritize healthcare workers. Notably, neither age, nor gender, explained this difference in vaccine allocation preference. Similarly, having direct experience with the COVID-19 disease did not affect the probability of prioritizing healthcare workers in receiving the vaccine.

Current results should be considered in light of some limitations of the study. First, as the survey was conducted online, we recruited a convenience sample that does not fully represent the population in Italy. Our findings did not extend to people who have no possibility or willing to access the internet and fill an online questionnaire. Also, we asked participants to rank seven occupations, but our participants were unequally distributed among these jobs. For instance, a single participant was a public safety worker, and thus we were forced to remove this category from the analysis of the self-preference effects. Results for the

other job categories should be considered with caution, given the unequal sample size. Similar care should be taken in the analyses for age groups: only eight participants were aged 85 or over.

Second, in investigating vaccine allocation preferences, we selected a few demographic and psychological variables that we believed were markedly relevant in this context. However, individual differences in other factors may also play a role. For instance, a recent study found that political parties influence vaccine allocation preferences (Reeskens et al., 2021; but see Duch et al., 2021). Hence, an interesting avenue for future studies is to investigate other demographic and psychological predictors of vaccine allocation preferences.

Despite these caveats, our results shed light on public opinion's attitudes and preferences in the priority of vaccine allocation. In Italy, at the time of the survey, the general public considered healthcare workers the first social group to be vaccinated. Older adults followed, while children and young adults were considered the social categories that could wait longer to receive the vaccine. Governments and policymakers should consider these attitudes to design effective communication campaigns, which could maximize the efficacy of the vaccination program. Of course, government vaccination programs should not simply conform to public preferences. However, the general population's opinion is useful for gaining public acceptance of the COVID-19 vaccination program proposed by the experts.

Data availability statement

The data that support the findings of this study are freely available on the Open Science Framework (OSF) repository, at the following link:

https://osf.io/6hdft/?view_only=a35600dc800f46cca9054bcff77460b1

Disclosure of interest

The authors report no conflict of interest.

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Tables

Table 1. Self-preference effects for age-based and job-based trials in the vaccine allocation ranking task.

	% at the top position in the ranking		χ^2
	Autoreferential group	*Other groups*	
Age-based trial			
18-30	3.50	4.17	0.15, $p = .701$
30-64	10.75	10.17	0.03, $p = .868$
65-84	10.99	14.46	0.75, $p = .386$
85+	87.50	61.45	2.26, $p = .133$
Job-based trial			
laborers	0.00	0.26	0.03, $p = .872$
teachers	0.00	0.27	0.03, $p = .857$
retired persons	19.28	9.00	**6.88, $p = .009$**
retailers	0.00	1.14	0.38, $p = .538$
healthcare workers	90.00	85.12	0.36, $p = .548$
students	1.33	1.27	0.00, $p = .959$

For each social category, the percentage of participants who put that social category at the top of the ranking is reported. Autoreferential group = the members of each social category. Other groups = all other participants, collapsed.

Table 2. Self-preference effects for age-based and job-based trials in the health vulnerability ranking task.

	% at the top position of the ranking		χ^2
	Autoreferential group	*Other groups*	
Age-based trial			
18-30	6.05	1.04	**7.51, *p* = .006**
30-64	5.38	3.63	0.61, *p* = .434
65-84	6.59	10.12	1.08, *p* =.299
85+	75.00	77.71	0.03, *p* = .855
Job-based trial			
laborers	0.00	0.27	0.03, *p* = .869
teachers	0.00	0.54	0.06, *p* = .799
retired persons	40.96	19.33	**16.24, *p* < .001**
retailers	3.03	2.86	0.00, *p* = .956
healthcare workers	80.00	69.15	1.05, *p* = .304
students	0.89	0.00	1.41, *p* = .235

For each social category, the percentage of participants who put that social category at the top of the ranking is reported. Autoreferential group = the members of each social category. Other groups = all other participants, collapsed.

Table 3. Self-preference effects for age-based and job-based trials in the economic backlash ranking task.

	% at the top position of the ranking		
	Autoreferential group	*Other groups*	χ^2
Age-based trial			
18-30	20.38	19.27	0.09, $p = .760$
30-64	62.37	61.50	0.02, $p = .876$
65-84	6.59	2.17	**5.06, $p < .025$**
85+	25.00	12.45	1.12, $p = .290$
Job-based trial			
laborers	20.00	9.38	1.26, $p = .263$
teachers	0.00	0.81	0.10, $p = .755$
retired persons	6.02	1.33	**6.23, $p = .013$**
retailers	60.61	65.43	0.31, $p = .579$
healthcare workers	15.00	20.94	0.41, $p = .523$
students	0.00	0.63	1.42, $p = .234$

For each social category, the percentage of participants who put that social category at the top of the ranking is reported. Autoreferential group = the members of each social category. Other groups = all other participants, collapsed.

Table 4. Correlation analyses between vaccine allocation, health vulnerability, and economic backlash rankings (aggregate trials).

		Health vulnerability	*Economic backlash*
Vaccine allocation	0-2	.43***	.22***
	2-11	.27***	.10
	11-18	.27***	.08
	18-30	.27***	.06
	30-64	.22***	.11
	65-84	.17**	.08
	85+	.26***	.10
	laborers	.32***	-.00
	teachers	.36***	.10
	retired persons	.37***	.19***
	retailers	.29***	.03
	healthcare workers	.27***	-.00
	public safety workers	.41***	.14*
	students	.26***	.12

Note. Statistical significance refers to the results of the Holm-Bonferroni correction for multiple comparisons. Spearman's rho is reported.

* $p < .01$, ** $p < .005$, *** $p < .00$

Table 5. Hierarchical logistic regression analysis predicting membership to the NHW group (i.e., people not prioritizing healthcare workers).

			Age	Gender	Education	Experience with COVID-19	BC	CC	Attitude toward vaccine
Step 1	χ^2 (3) = 35.76 ***p* < .001** Nagelkerke's R^2 = .11	*B (SE)*	-.00 (.01)	-.24 (.26)	-.73 (.16)				
		p	.697	.362	**< .001**				
		Odds ratio	1.00	0.79	0.48				
		95% CI	0.99 - 1.01	0.48 - 1.31	0.35 - 0.66				
Step 2	χ^2 (1) = 0.14 *p* = .712 Nagelkerke's R^2 = .11	*B (SE)*	.00 (.01)	-.24 (.26)	-.73 (.16)	.09 (.24)			
			.700	.361	**< .001**	.711			
		Odds ratio	1.00	0.79	0.48	1.09			
		95% CI	0.99 - 1.01	0.47 - 1.31	0.35 - 0.66	0.68 - 1.76			
Step 3	χ^2 (1) = 3.15 *p* = .076 Nagelkerke's R^2 = .12	*B (SE)*	.00 (.01)	-.28 (.26)	-.74 (.16)	-.02 (.25)	.01 (.01)		
		p	.839	.292	**< .001**	.926	.078		
		Odds ratio	1.00	0.76	0.48	0.98	1.01		
		95% CI	0.99 - 1.01	0.46 - 1.27	0.35 - 0.65	0.60 - 1.60	1.00 - 1.02		
Step 4	χ^2 (1) = 1.08 *p* = .298 Nagelkerke's R^2 = .12	*B (SE)*	.00 (.01)	-.24 (.26)	-.77 (.16)	-.08 (.26)	.01 (.01)	-.01 (.01)	
		p	.941	.368	**< .001**	.751	**.048**	.299	
		Odds ratio	1.00	0.79	0.46	0.92	1.01	0.99	
		95% CI	0.99 - 1.01	0.47 - 1.32	0.34 - 0.64	0.56 - 1.53	1.00 - 1.02	0.98 - 1.01	
Step 5	χ^2 (1) = 15.59 ***p* < .001** Nagelkerke's R^2 = .17	*B (SE)*	.00 (.01)	-.23 (.27)	-.74 (.16)	-.16 (.26)	.01 (.01)	-.01 (.01)	-.40 (.10)
		p	.668	.405	**< .001**	.539	**.020**	.175	**< .001**
		Odds ratio	1.00	0.80	0.48	0.85	1.01	0.99	0.67
		95% CI	0.99 - 1.02	0.47 - 1.36	0.35 - 0.66	0.51 - 1.42	1.00 - 1.03	0.98 - 1.00	0.55 - 0.82

Note. BC = belief of contagion scale from the Fear of COVID-19 questionnaire; CC = consequences of contagion scale from the Fear of COVID-19 questionnaire.

Figure captions

Figure 1. Stacked bar chart (100%) showing the rankings for vaccine allocation in the three trials (age-based, job-based, aggregate).

Figure 2. Stacked bar chart (100%) showing the rankings for health vulnerability in the three trials (age-based, job-based, aggregate).

Figure 3. Stacked bar chart (100%) showing the rankings for economic backlash in the three trials (age-based, job-based, aggregate).