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Stepping into the shoes of the policy maker: Results of a Participatory Value Evaluation for the Dutch long term COVID-19 strategy

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ABSTRACT

Background: The COVID-19 outbreak early 2020 was followed by an unprecedented package of measures. The relative calmness of the pandemic early 2022 provides a momentum to prepare for various scenarios.
Objectives: As acceptance of COVID-19 measures is key for public support we investigated citizens' preferences towards imposing measures in four scenarios: 1) spring/summer scenario with few hospitalizations; 2) autumn/winter scenario with many hospitalizations; 3) a new contagious variant, the impact on hospitalizations is unclear; 4) a new contagious variant, hospitalizations will substantially increase.
Methods: Study 1 comprised a Participatory Value Evaluation (PVE) in which 2011 respondents advised their government on which measures to impose in the four scenarios. Respondents received information regarding the impact of each measure on the risk that the health system would be overloaded. To triangulate the results, 2958 respondents in Study 2 evaluated the acceptability of the measures in each scenario.
Results: Measures were ranked similarly by respondents in Study 1 and 2: 1) the majority of respondents thought that hygiene measures should be upheld, even in the spring/summer; 2) the majority supported booster vaccination, working from home, encouraging self-testing, and mandatory face masks from scenario 2 onwards; 3) even in scenario 4, lockdown measures were not supported by the majority. Young respondents were willing to accept more risks for the health system than older respondents.
Conclusion: The results suggest that policies that focus on prevention (through advising low-impact hygiene measures) and early response to moderate threats (by scaling up to moderately restrictive measures and boostering) can count on substantial support. There is low support for lockdown measures even under high-risk conditions, which further emphasizes the importance of prevention and a timely response to new threats. Our results imply that young citizens' concerns, in particular, should be addressed when restrictive COVID-19 measures are to be implemented.

1. Introduction

The outbreak of COVID-19 early 2020 was followed by an unprecedented package of measures. The spread of the Omicron strain of the coronavirus in the winter of 2021/2022 resulted in a new phase of the pandemic in the sense that Omicron has caused less severe illness compared to previous variants such as Alfa and Delta. Hence, for many countries ICU capacity no longer seemed to be a constraint that policy makers needed to take into account in their decision making.

This phase in the COVID-19 pandemic provides a momentum to carefully prepare for different scenarios in the autumn and winter of 2022. As acceptance of COVID-19 measures is a key for their success, the preferences for COVID-19 measures have been studied via regular surveys and more advanced methods, such as discrete choice experiments

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(Betsch et al., 2020; Blayac et al., 2020; Habersaat et al., 2020; Krauth et al., 2021; Loría-Rebolledo et al., 2022; Ozdemir et al., 2021; Sicsic et al., 2022).

For instance, Krauth et al. (2021) find that German citizens are sceptical about the implementation of severe measures, such as a mandatory COVID-19 tracing app, and at the same time they are cautious about extensive re-opening strategies. Sicsic et al. (2022) show, amongst other things, that a targeted lockdown for sectors with high COVID-19 incidence, medically prescribed self-isolation, and restrictions in nursing homes are likely to be accepted by French citizens when these measures would avoid an overload of intensive care units. Moreover, Krauth et al. (2021) and Sicsic et al. (2022) find that French and German citizens who felt they had a high risk of becoming ill after a COVID-19 infection, and individuals expressing high confidence in information about COVID-19 from government institutions, are relatively positive about COVID-19 restrictions. In addition, Ozdemir et al. (2021) find that Singaporeans generally preferred border control policies compared to internal policies, that the fatality rate was the most important factor for predicting public support for policies, and that perceived effectiveness of a policy was a positive predictor of public support. Analyses of data gathered in 23 countries showed that higher trust in government regarding COVID-19 control was significantly associated with higher adoption of health behaviours (Han et al., 2021). This relationship was also found in Japan (Gotanda et al., 2021).

To allow the Dutch government to align their long term COVID-19 strategy with its citizens' preferences, the Dutch National Institute for Public Health and the Environment (RIVM) decided to conduct a Participatory Value Evaluation (PVE) in which citizens could express which measures should be imposed in four scenarios that can unfold after the Omicron wave. PVE is a preference elicitation method that facilitates citizens to give advice on government decisions in an easy-to-access manner (Mouter et al., 2021a). The essence of a PVE is that citizens are put in the shoes of a policymaker. In the present PVE, respondents are provided with information about the scenario, including the risk that hospitals run into problems when no additional measures are imposed. Next, respondents are presented with measures that the government can impose, including the extent to which the measure affects the chance of hospitals becoming overcrowded. Subsequently, citizens are asked which measures they would recommend to the government. PVE was also applied in the Netherlands at the first phase of the COVID-19 pandemic to investigate citizens' preferences for alleviating lockdown measures (Mouter et al., 2021a), and PVE was also deployed in other domains, such as the energy transition (Itten and Mouter, 2022) and flood protection policies (Mouter et al., 2021b). To triangulate the results of the PVE, we conducted a second study in which citizens evaluated the same measures in the context of the four scenarios, but participants in this second study were asked to rate the acceptability of the measures on a five-point Likert scale.

Based on participants' choices in the PVE, we could examine how citizens' preferences of COVID-19 measures are affected by their effectiveness in terms of reducing the chance of the health sector becoming overloaded and whether preferences differ among subgroups in the population. Moreover, we identify which risk levels are accepted by citizens in each of the scenarios. Hence, our study provides insights for policy decisions on risk levels that the public is willing to accept, and measures to impose in different COVID-19 scenarios. This is the main distinction between our study and other studies focusing on the elicitation of preferences for COVID-19 measures. Our subgroup analyses can be used to identify, and potentially provide ways to resolve, conflict between subgroups of the population about policy decisions. Finally, our paper provides a methodological contribution as we study the extent to which citizens rank COVID-19 measures differently in terms of their desirability when they actively provide advice while being in the role of a policy maker, and when participants are asked which measures they would find acceptable in a certain policy scenario.

2. Methodology

2.1. Selection of the preference elicitation method

Policy makers are often confronted with choice problems in which they have to decide about the extent to which scarce public resources – such as a constrained public budget or the capacity of the health sector – are allocated. The extent to which they want to allocate these public resources not only depends on their preferences toward allocating a certain share of the public resource(s) under scrutiny, but also on the attractiveness of the available policy options. The key strength of the PVE preference elicitation method is that respondents can directly express preferences toward specific policy options and the allocation of scarce public resources in relation to each other (Mouter et al., 2021a). We selected PVE for this study because the policy makers who commissioned this study were interested in (the relation between) citizens' preferences for COVID-19 measures and the extent to which they are willing to accept the risk of the health care sector becoming overloaded (i.e. the allocation of scarce capacity within the health care system).

2.2. Specifics of the PVE

We selected the four scenarios that were presented in a policy document from the Minister of Health to the Dutch Parliament (Kuipers and van Gennip, 2022), but we reformulated them to make them more understandable for respondents. Below, we provide the description of the four scenarios.

Scenario 1: Few people with COVID-19 are in the hospital. Hospitals do not have to postpone operations. There is no dangerous new variant of the virus causing problems.

Scenario 2: Autumn has begun. COVID-19 spreads faster. Vulnerable people and people who have not been vaccinated, especially, end up in hospital. Some hospitals have to postpone minor operations, but major operations can still go ahead. There are now some basic rules like 'wash your hands', 'keep 1.5 m distance' and 'get tested when you have complaints', but this is not enough to prevent hospitals from becoming increasingly crowded.

Scenario 3: In another country, a new variant of COVID-19 has been found which spreads faster. It is unclear how sick people are getting from this new variant. Restrictions on entering the country are in place as well as basic rules, such as 'wash your hands', 'keep 1.5 m distance' and 'get tested if you have symptoms'. The government expects hospitals to be busier soon. In the best case, hospitals do not have to postpone operations. In the worst case, all hospitals have to postpone major operations.

Scenario 4: In another country, a new variant of COVID-19 has been found which spreads faster. It is clear that many people are getting very sick from this new variant. Restrictions on entering the country are in place as well as basic rules, such as 'wash your hands', 'keep 1.5 m distance' and 'get tested if you have symptoms'. Furthermore, stricter measures are already in place such as 'ban on large events', 'restriction of capacity in the catering industry', but this will not be enough to prevent hospitals from becoming increasingly crowded. If the government does not take additional measures soon, hospitals will become so crowded that major operations will have to be postponed. In the worst case, some patients who need to visit the hospital will no longer be able to.

The core of the choice task in the PVE is that respondents were asked to make a trade-off between imposing a (portfolio of) COVID-19 measure(s) and the risk of the health sector getting into problems. A visual indicator provided respondents with information of the risk of the health sector getting into problems when no additional measures were imposed. For all the measures respondents could choose they saw the effect on the reduction in risk of the health sector running into problems should the measure be imposed. After being provided with this

information, respondents were asked which measures they would impose if they were the policy maker. In essence, respondents were asked to make a continuous choice regarding the extent to which they are willing to accept the risk of the health care sector becoming overloaded and discrete choices as to whether or not to include specific COVID-19 measures in the bundle that they would recommend to the policy maker.

Prior to the choice tasks, respondents saw an instruction video which explained the essence of the choice task. In the video, it was also explained that the chance of problems arising in the hospitals in the coming months would be small if the visual indicator was green (risk that the health sector becomes overloaded is between 0% and 35%). If the indicator was orange, it would likely be busy in the hospitals in the coming months. Minor operations would have to be postponed. There would also be a chance that hospitals would have to postpone major operations (risk is between 35% and 70%). A red indicator meant that it

would be very busy in hospitals in the coming months. Too many people would need care because of COVID-19. Hospitals would have to postpone small and large operations (risk is between 70% and 100%). Participants could not continue if the indicator was red. This was only the case in scenario 4 where the risk that the health sector would run into problems was 100% when no measures were imposed.

Fig. 1A shows an example of the start of the PVE choice task from scenario 1. The visual indicator in the top right of the screen shows the risk of problems occurring in the hospitals. In the initial situation, this probability is 45%. Fig. 1B shows that a participant selected a number of measures, which lowered the risk of problems in hospitals.

To investigate the extent to which respondents' choices were affected by the effectiveness of measures (i.e. how much each measure reduces the risk of the health sector becoming overloaded), respondents were presented with different levels of effect estimates. In consultation with three experts, i.e. epidemiologists and infection modellers, we

A: Example of the choice screen at the start of the choice task in scenario 1.
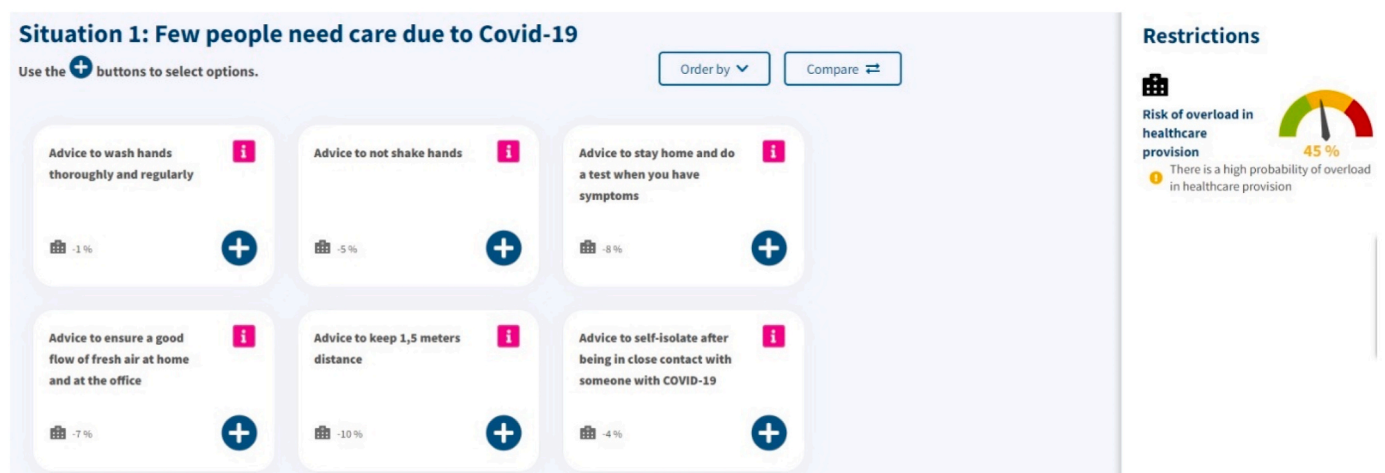
B: Example of the choice screen when a respondent selected various measures
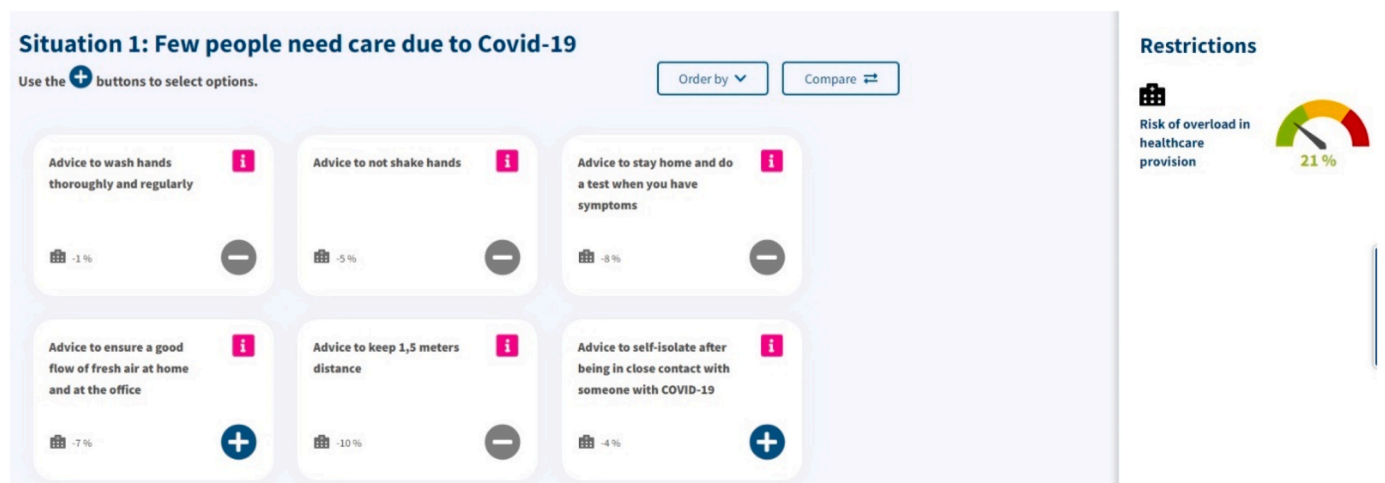
At the bottom-left you see the measures that respondents could advise including how much a measure reduces the risk of the health sector becoming overloaded. The visual indicator in the top right of the screen shows the risk of problems occurring in the hospitals.

Fig. 1. A: Example of the choice screen at the start of the choice task in scenario 1. B: Example of the choice screen when a respondent selected various measures. At the bottom-left you see the measures that respondents could advise including how much a measure reduces the risk of the health sector becoming overloaded. The visual indicator in the top right of the screen shows the risk of problems occurring in the hospitals.

defined three levels of effect estimates per measure and scenario (details can be found in the supplementary material). The experts were able to define ranges of the effectiveness of measures based on, amongst other things, the results of the models they used themselves and the outcomes of Fieldlab studies in which the effectiveness of non-pharmaceutical interventions was tested (www.fieldlabevenementen.nl). We used these ranges for defining the three levels. The experts were not aware of any solid scientific evidence which would provide accurate point estimates for the effectiveness of single measures. In their view, robust evidence concerning the effectiveness of single measures was missing as in real-life no measures were implemented in isolation over the course of the COVID-19 pandemic. Secondly, they argued that the effectiveness of measures is substantially influenced by people's compliance with measures, and the fact that compliance can deviate over the course of the pandemic also warrants the use of ranges for effect estimates instead of point estimates.

We generated different combinations of effect estimates that were shown to participants, aiming that the levels of effect estimates were statistically independent across measures of the same scenario, following standard practices of choice experiments design. In total, we generated 54 different combinations of effect estimates per scenario.

An important criterion for avoiding hypothetical bias in a preference elicitation study is that 'consequentiality' is ensured which entails that respondents must feel that their choices might potentially have consequences in real life (e.g. Carson and Groves, 2007). We secured consequentiality, by (truthfully) informing respondents that the outcomes of this study would be shared with high-ranking policy makers at relevant Ministries. A Dutch language report of our study was cited in the long term COVID-19 strategy of the Dutch government (Kuipers and van Gennip, 2022). To reduce cognitive overload, we asked respondents to advise the government in three out of the four scenarios.

2.3. Data collection

The participants in both experiments were sampled from the online Dynata panel, with a view to be representative for the Dutch population. The Human Research Ethics Committee of TU Delft approved our study protocol (Nr. 1991). Study 1 ran from 3 February to February 10, 2022 and a total of 2011 participants completed the questionnaire (response rate 65%). The full list of questions can be found in the supplementary

material. Study 2 ran from 18 February to March 1, 2022 and a total of 2958 participants completed the questionnaire (response rate 70%). At the time that we conducted our studies, around 200 citizens were hospitalised per day and the Dutch government was in the process of alleviating lockdown measures (see Fig. 2).

Table 1 gives an overview of socio-demographic characteristics of the two samples. Because some strata were slightly under or over-represented, the data were weighted in all analyses for both surveys using post-stratification weights. Based on the characteristics of gender (2 groups), age (7 groups) and highest education level attained (3 groups), the participants could be divided into 42 different strata. The relative size of each of these strata was compared to that of the Dutch population in 2021 (Statistics Netherlands, 2022). The weight of each stratum was then calculated by dividing the proportion of the population by the proportion of the sample.

2.4. Statistical analysis

2.4.1. Portfolio choice model
We first analysed the data using a portfolio choice model proposed

Table 1
Socio-demographic characteristics of respondents. Chi-square tests (2-sided) for all characteristics are significant at p < 0.01

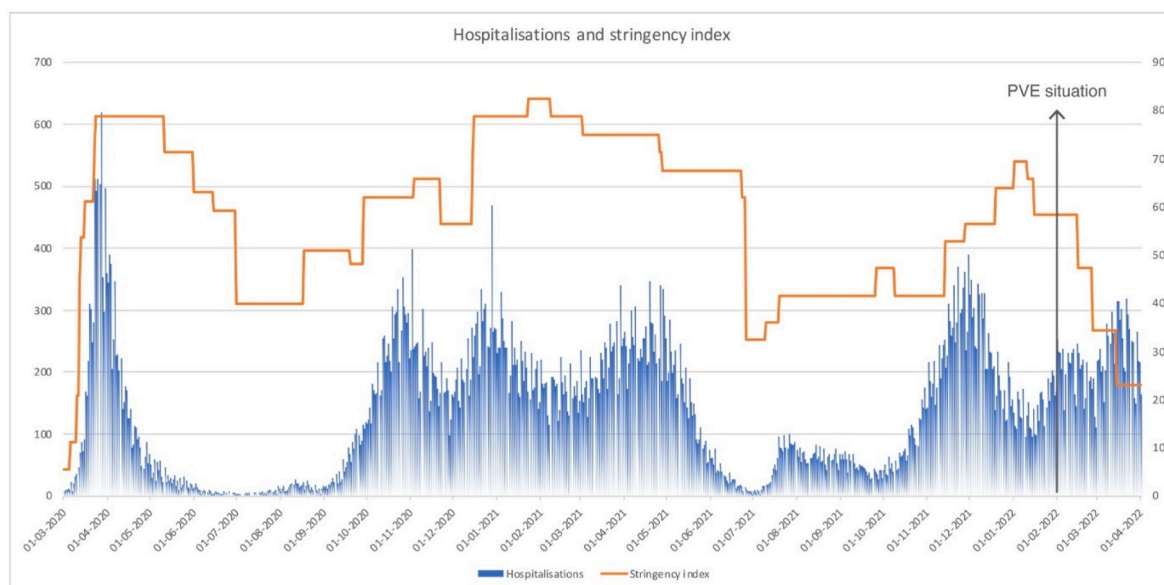|	Study 1 (2011)	Study 2 (2958)	Census
Gender			
Male	45.9%	46.5%	49.5%
Female	54.1%	53.5%	50.5%
Age			
18–24 year	8.5%	10.0%	14.8%
25–34 year	14.6%	15.2%	15.4%
35–44 year	15.2%	15.0%	14.1%
45–54 year	18.3%	17.4%	16.4%
55–64 year	16.5%	18.7%	16.3%
65–74 year	20.7%	16.6%	13.4%
75 year or older	6.1%	7.1%	9.7%
Education			
Low education	24.8%	22.9%	29.0%
Middle education	38.2%	39.0%	36.6%
High education	37.0%	38.1%	34.4%
Vaccination status			
Vaccinated	87.6%	87.2%	86.4%

Fig. 2. The 'PVE situation' indicates the context of the COVID-19 pandemic in which our study took place. The stringency index indicates the strictness of COVID-19 measures.

by Bahamonde-Birke and Mouter (2019). This model assumes that participants seek to maximise a utility function that depends on the combination of selected measures, their impacts and the non-spent resources.

We used a portfolio choice model because of its flexibility to handle both the absence and presence of resource constraints. We could not use the model that was used for analysing the data of previous PVE experiments – the Multiple Discrete Continuous Extreme Value model (MDCEV) – as this approach is only applicable to constrained optimization problems, such as scenario 4 in this study, and not applicable to optimization problems without a resource constraint, such as scenarios 1, 2 and 3.

Specifically, we assume the utility of an individual *n* for choosing the combination of measures *p* is given by:

$$U_{np} = V_{np} + \varepsilon_{np} = \sum_{j=1}^{J} y_{nj} \cdot \delta_j + \delta_0 \left(\sum_{j=1}^{J} y_{nj} \cdot c_{nj} \right) + \varepsilon_{np}$$

Where y_{nj} indicates if the measure *j* is chosen, δ_j is a measure-specific constant for measure *j*, δ_0 is a parameter that accounts for the marginal effect of not spending resources, *B* is the total amount of resources, c_{nj} is the cost of resources of measure *j*, and ε_{nj} is a stochastic error term with an extreme value (Gumbel) distribution. In the portfolio choice model, we assume that individuals choose the combination of measures from which they derive the highest expected utility (i.e. the optimal portfolio), compared with all the other feasible portfolios. More specifically, the probability of choosing a combination of measures is equal to:

$$P_{np} = P \left(U_{np} \geq U_{nq}, \forall q \neq p \right) = \frac{exp(V_{np})}{\sum_{c} exp(V_{nc})}$$

where *c* is part of the set of all possible combinations. Portfolios that violate the resource constraint have a utility equal to minus infinity, hence their choice probability is equal to zero. Notice that the probability of choosing a combination of measures takes the form of a multinomial logit (MNL) model in which each possible combination of measures is a single alternative.

The estimated parameters (the δ_j terms and δ_0) have an economic interpretation. Specifically, the δ_j terms represent the average increase (if positive) or decrease (if negative) of utility of choosing a certain measure, compared with the measure for which the measure-specific constant is fixed to zero. δ_0 is a parameter that accounts for the marginal change of utility for reducing 1 percent of risk of overloading the healthcare system. If $\delta_0 > 0$ then, on average, participants prefer to reduce risk of overloading the healthcare system, and vice versa if $\delta_0 < 0$.

The estimated parameters can be used to estimate the utility function for a combination of measures and to determine the optimal portfolio, which is the combination of measures that maximises society's welfare. The optimal portfolio is computed by enumerating the expected utility of each combination of measures that respect the resource constraint, and by identifying the combination that maximises expected utility. To compute an approximation of the expected utility, the utility of each combination of measures is repeatedly computed using random values for the stochastic term ε_{np} and then the average across repetitions is computed (see the supplementary material for a detailed description).

Finally, the portfolio choice model can be used to compute the (logit) probability that a certain combination of measures is better than choosing the minimum portfolio, computed as $P(V_i > V_0)$, where V_0 is the utility from the minimum portfolio. In scenarios 1, 2 and 3, the minimum portfolio is equivalent to not choosing any measure. In scenario 4, the participants were required to choose a combination of measures that reaches 30% of risk reduction. Hence, for the minimum portfolio we selected a combination of measures which precisely reached this target through implementing the least number of measures. Sensitivity analyses showed that choosing another minimum portfolio

would not change the results.

2.4.2. Latent class cluster analysis

Apart from the portfolio choice models discussed in section 2.4.1 we analysed the choices of the participants using Latent Class Cluster Analyses (LCCA). LCCA is ideally suited to identify common patterns in the measures that were recommended by different groups (clusters) of people. The various COVID-19 measures were included as (nominal) indicators of the latent classes. Based on maximum likelihood estimation, the model identifies clusters that are maximally homogeneous within the clusters (consisting of people with similar patterns of support for the various measures) and maximally different between the clusters.

A benefit of LCCA is that covariates can be included in the model to assess their associations with class membership. In doing so, the analysis can reveal which segments of the population (e.g. in terms of age, gender) are relatively frequently a member of a certain cluster. This makes it possible to determine which (combinations of) measures are relatively 'popular' among certain groups of participants. This subgroup analysis – which cannot be made based on the portfolio choice models – can be used to identify, and potentially provide ways to resolve, conflict between subgroups of the population about COVID-19 policy decisions.

The following covariates were considered in the analyses: gender, age, level of education, perceived risk of infection, whether the respondent took the COVID-19 vaccine and/or booster, perceived limitations in the way of living due to the pandemic, impact on social life, compliance with measures, unemployment and/or financial problems experienced due to the COVID-19 crisis, and levels of trust in various institutions.

The goal of the LCCA is to find the most parsimonious model, i.e. with the smallest number of latent classes, which (still) adequately describes the associations between the indicators. To identify the optimal number of latent classes for each scenario, subsequent models were estimated with 1–8 latent classes using Latent Gold (Vermunt and Magidson, 2013). Based on the Bayesian information criterion value, the optimal models for scenarios 1–4 were 4, 6, 5 and 5 classes, respectively.

After establishing the optimal number of latent classes, the covariates were added to the model. In this step only significant covariates were retained in the models, as shown in the results of the LCCA for each scenario (at 5% level of significance).

To ease the interpretation of the model the logit coefficients have been transformed to probabilities (expressed as percentages) using the logit function (because the indicators are specified as nominal in the model). This probabilistic parametrization of the model is provided by the software used to estimate the models, by default (Latent Gold), see Vermunt and Magidson (2013, p.79).

3. Results

In section 3.1 we present descriptive statistics regarding the COVID-19 measures that were advised by participants in Study 1 and regarded (un)acceptable by participants in Study 2. In section 3.2 we present how citizens' preferences for COVID-19 measures are affected by their effectiveness in terms of reducing the chance of the health sector becoming overloaded. In section 3.3 we explore whether preferences differ among subgroups.

3.1. Descriptive statistics

Firstly, Table 2 reports what percentage of the participants in Study 1 recommended certain measures in the different scenarios. Between brackets we report what percentage of the participants in Study 2 find the same measures (very) acceptable. Note that in Study 1 respondents could choose between two versions of the vaccination passport (2G or 3G) in scenario 2 and 3, and between two versions of an evening lockdown (from 5pm or from 8pm) in scenario 4. For reasons of readability we aggregated the percentages of respondents who recommended these

Table 2
Model fit results of LCCA models across the four scenarios.

Sample	Scenario 1 (N = 1768)			Scenario 2 (N = 1768)			Scenario 3 (N = 889)			Scenario 4 (N = 879)		
No. of classes	Npar	LL	BIC(LL)	Npar	LL	BIC(LL)	Npar	LL	BIC(LL)	Npar	LL	BIC(LL)
1	9	−10493.4	21054.0	14	−15199.4	30503.5	14	−7583.8	15262.8	13	−7136.4	14360.9
2	19	−9070.2	18282.4	29	−13816.4	27849.7	29	−6585.3	13367.6	27	−6707.9	13598.7
3	29	−8684.9	17586.7	44	−13264.4	26857.7	44	−6291.5	12881.8	41	−6524.9	13327.7
4	39	−8619.2	**17530.1**	59	−13103.3	26647.7	59	−6186.2	12773.0	55	−6428.8	13230.4
5	49	−8586.8	17539.9	74	−12990.3	26534.0	74	−6123.0	**12748.5**	69	−6375.9	**13219.6**
6	59	−8562.8	17566.9	89	−12926.2	**26517.8**	89	−6076.1	12756.5	83	−6340.5	13243.6
7	69	−8541.8	17599.5	104	−12881.1	26539.8	104	−6040.1	12786.4	97	−6294.7	13246.9
8	79	−8522.4	17635.4	119	−12839.2	26568.2	119	−6015.2	12838.4	111	−6264.9	13282.2

Npar Number of parameters.
LL Log-Likelihood.
BIC(LL) Bayesian Information Criterion (based on Log-Likelihood).

variants in Table 2.

Table 3 shows that for scenarios 1–3 the acceptance of measures is generally higher than the proportion of participants who recommended the measures to the government in Study 1. This is different in scenario 4, but note that participants in Study 1 were obliged to recommend (a portfolio of) measures which ensure that the risk that the health sector would run into problems was reduced to under 70%. In general, we see that the ranking of measures is similar in Studies 1 and 2; all rank-order correlations are above 0.70 (presented in the last row). Moreover, for both studies we can conclude that the respondents' preferences hardly differ between scenarios 2 and 3.

Furthermore, Table 3 shows that in scenario 1, all the measures - with the exception of the vaccination passport - were considered acceptable by at least 50% of the respondents. The most popular measures in scenarios 2–4 were a booster campaign, the strict obligation to work from home, encouraging self-tests and the obligation to wear mouth masks. In both studies there was little enthusiasm for measures that significantly limit people's freedom, such as closing down certain sectors.

3.2. Results of choice models and latent class cluster analyses

We estimated a choice model and computed the optimal portfolio for each scenario. To be succinct, we only present the estimation results for scenario 1. In the supplementary material we present the estimation results of the other scenarios and sensitivity analyses which show how the optimal portfolios change when we make other assumptions for the effectiveness of the measures. Similarly, we present the full results of the LCCA for scenario 1 and provide an elaborate presentation of the LCCA results for the other scenarios in the supplementary material.

3.2.1. Scenario 1

Table 4 summarises the estimation results of the portfolio choice model for scenario 1. Almost all estimated parameters are statistically significant at 90%, except for the constant for recommending ventilating well. The parameter of the advice to not shake hands is positive, which implies that respondents prefer this measure even in a situation when it would not have any impact on the pressure of the healthcare system. The parameters of all the other measures are negative which means that respondents inherently dislike these measures. The estimate for the marginal utility of reducing the risk of overloading the healthcare system is positive and statistically significant, which implies that, on average, the utility that participants derive from the measures increases when the risk of overloading the healthcare system is reduced. To illustrate, from Table 4 it can be inferred that the advice to keep 1.5 m distance should result in around 10.8% reduction of the risk that the healthcare system will become overloaded ($-0798/0.074$) to ensure that the average individual gains a positive utility from this measure.

The optimal portfolio of scenario 1 (Table 5) suggests that the best package of measures consists of implementing the advice to wash hands,

not to shake hands, to stay at home when you have symptoms, and to frequently ventilate, which results in a risk reduction of the health system becoming overloaded of 22.1% and has an 83% probability of being better than not choosing any measure. Conversely, more invasive measures, such as imposing a mouth mask mandate and a vaccination passport (which are inherently disliked by participants - see the very negative parameter in Table 4) are not part of any of the five highest-ranked portfolios.

The Latent Class Cluster Analysis (LCCA) identified four clusters for scenario 1. Table 6 shows the results.

The majority of the participants in Cluster 1 (19% of the sample) recommend all the measures. The majority of the participants in Cluster 2 (27%) advise the government to maintain all the measures, except the obligation to wear mouth masks and the vaccination passport. The majority of the largest Cluster 3 (39%) advises to wash hands properly and to stay at home in case of COVID-19 symptoms, but rejects other measures. Finally, all but a few participants in Cluster 4 (15%) want all measures to be abolished. The optimal portfolio(s) presented in Table 5 strongly aligns with the preferences of Clusters 2 and 3. Women are overrepresented in Clusters 1 and 2, where they are relatively positive about keeping advice, such as 'no handshaking', 'keep 1.5 m distance' and 'stay at home in case of symptoms'. Older people are relatively strongly represented in Cluster 1, where people are positive about all measures. Low-educated people, people out of work due to the pandemic and people who have run into financial problems are overrepresented in the more extreme Clusters 1 and 4. Finally, vaccinated individuals and people who comply with COVID-19 measures are more likely to be found in Cluster 1 than in Cluster 4.

3.2.2. Scenario 2

For scenario 2, the optimal portfolio is composed by starting a booster vaccination campaign, implementing the advice of working from home, and encouraging the use of self-tests, resulting in a risk reduction of the health system becoming overloaded of 28.7% and a 75% probability of being better than not choosing any measure. Congruently, with the descriptive statistics presented in Table 3, implementing a booster campaign and encouraging self-testing is part of the five highest-ranked portfolios. On the other hand, measures that may compromise peoples' daily life, such as vaccination passports, do not end up in the optimal portfolios.

For scenario 2 six classes were identified in the LCCA. Participants in Cluster 1 (10% of the sample) recommend the majority of the measures. More than 70% of the participants in Cluster 2 (31%) and 60% in Cluster 3 (12%) advise the obligation to wear a face mask in public transport, shops and restaurants, starting a booster campaign, strict advice to work from home and encouraging self-testing. Participants in Cluster 4 (14%) are positive about strict advice to work from home and encouraging self-testing. They are very negative about the COVID-19 certificate. Moreover, the booster campaign is advised by relatively few participants. In Cluster 4, the booster rate is relatively low at 23%. Relatively few

Table 3
Share of respondents in Study 1 that advises a certain measure, per scenario. Between brackets: share of respondents in Study 2 that finds a certain measure acceptable, per scenario.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Advice to wash hands frequently and thoroughly	66% (86%)			
Advice to stay at home with COVID-19 symptoms and to do a test	60% (76%)			
Advice not to shake hands	56% (69%)			
Advice to ventilate	56% (82%)			
Advice to keep 1.5 m distance	48% (57%)			
Quarantine if in intensive contact with person infected with COVID-19	47% (69%)			
Advice to work at home a few days a week	45% (67%)			
Advice to work at home, unless it is absolutely necessary		55% (75%)	57% (69%)	83% (76%)
Mouth mask obligation in public transport/shops/ hospitality industry	32% (50%)	50% (66%)	53% (63%)	
Vaccination passport hospitality industry (2G or 3G)	25% (43%)	46% (46%)	43% (42%)	45% (46%)
Vaccination passport for people working with vulnerable people		26% (52%)	28% (52%)	50% (53%)
Encourage self-testing by making it available free of charge		56% (72%)	50% (73%)	
Starting a booster campaign which starts with vulnerable people		57% (74%)	58% (69%)	80% (76%)
Requiring shops to offer time slots for people with vulnerable health		34% (48%)	32% (45%)	
Limit number of customers per square metre in non-essential shops		36% (55%)		
Pick up orders in non-essential shops		17% (32%)	17% (29%)	44% (38%)
1/3 capacity and fixed seating at events		30% (41%)	31% (38%)	
Banning festivals and major sporting events		35% (43%)	34% (41%)	
Strict advice not to have more than 2 visitors per day at home		30% (30%)	31% (33%)	55% (36%)
Advice higher education online and maximum number of students per college		26% (50%)	32% (46%)	62% (55%)
Lockdown after 5pm or 8pm			21%	56% (30%)
Closing restaurants/cafés				40% (25%)
Closing sports venues				45% (25%)
Closing cinemas, theatres, concert halls				41% (32%)
Closing primary/secondary schools				41% (22%)
Spearman's Rho correlation	0.903*	0.730*	0.749*	0.759*

*Correlation is significant at p < 0.01.

Table 4
Estimation results of the portfolio choice model, scenario 1.

	Estimate	Std. Err	T-Value
Marginal utility of reducing the risk of overloading the healthcare system	0.074	0.011	6.525
Measure-specific constants			
Advice to wash hands frequently/thoroughly	0	-	-
Advice not to shake hands	0.130	0.078	1.658
Advice to stay at home with COVID-19 symptoms and to do a test	−0.274	0.139	−1.967
Advice to ventilate	−0.004	0.086	−0.051
Advice to keep 1.5 m distance	−0.798	0.130	−6.133
Quarantine if in intensive contact with person infected with COVID-19	−0.527	0.093	−5.690
Vaccination passport hospitality industry (3G)	−1.486	0.087	−17.085
Mouth mask obligation in public transport, shops and hospitality industry	−1.046	0.081	−12.846
Advice to work at home a few days a week	−0.357	0.071	−4.996
Log-likelihood	−6079.80		

Table 5
Optimal portfolio(s), scenario 1.

Rank	1st	2nd	3rd	4th	5th
Advice to wash hands frequently/thoroughly	X	X		X	X
Advice not to shake hands	X	X	X	X	X
Advice to stay at home with COVID-19 symptoms and to do a test	X	X	X	X	X
Advice to ventilate	X	X	X	X	X
Advice to keep 1.5 m distance		X			
Quarantine if in intensive contact with person infected with COVID-19				X	
Vaccination passport hospitality industry (3G)					
Mouth mask obligation in public transport, shops and hospitality industry					
Advice to work at home a few days a week					X
Reduction of risk	22.1%	32.0%	20.1%	28.0%	25.1%
Probability of being better than minimum portfolio	82.7%	81.5%	81.9%	80.7%	79.9%

participants in Cluster 5 (8%) advise the obligation to wear face masks, starting a booster campaign, strict advice for home working and encouraging self-testing. These participants are relatively positive about heavier measures, such as banning festivals and events and the rule that orders from non-essential shops can only be collected. The booster rate of this cluster is relatively high, as is the trust in information from the Outbreak Management Team and the Prime Minister. The vast majority of Cluster 6 participants (24%) believe that the government should not introduce any of the measures in this scenario. The optimal portfolio(s) presented in Table 7 strongly aligns with the preferences of Clusters 2 and 3. Young people are strongly overrepresented in Clusters 4–6, where they are negative about measures, while older people are over-represented in Clusters 1–3. People who think they are at high risk of becoming ill after a COVID-19 infection and adhere to the compulsory use of masks are more likely to belong to Clusters 1–3. As in Scenario 1, low-educated people and people who have run into financial problems because of the crisis are relatively strongly represented in the clusters with a strong opinion.

3.2.3. Scenario 3

The optimal portfolio of scenario 3 (Table 8) suggests that the best package of measures is to implement a mask mandate, start with a booster campaign, and to encourage self-testing, with an average

Table 6
Results of the LCCA for scenario 1 in which the COVID-19 situation is under control and few people with COVID are in hospital.

	Cluster 1 (19%)	Cluster 2 (27%)	Cluster 3 (39%)	Cluster 4 (15%)
Advice to wash hands often/ thoroughly	96%	93%	60%	6%
Advice to stay at home with symptoms and to do a test	98%	83%	52%	4%
Advice not to shake hands	91%	89%	42%	2%
Advice to ventilate	98%	87%	43%	3%
Advice to keep 1.5 m distance	96%	60%	39%	1%
Quarantine if in intensive contact with someone with COVID-19	99%	64%	31%	2%
Advice to work from home a few days a week	92%	55%	35%	4%
Compulsory face mask in public transport, shops and restaurants	91%	22%	24%	2%
Vaccination passport in the hospitality industry	68%	15%	20%	7%
Characteristics of cluster members				
Female	60%	59%	48%	49%
18–34 years	8%	17%	17%	19%
35–64 years	51%	52%	51%	57%
65+ years	40%	26%	23%	24%
Low-educated	34%	19%	20%	30%
Average-education	37%	33%	45%	35%
Highly-educated	29%	48%	35%	35%
Vaccination rate	98%	90%	87%	79%
I have no work because of the COVID crisis	4%	1%	3%	4%
Due to the COVID crisis I have financial issues (1.0 = strongly agree; 0.0 = strongly disagree)	0,31	0,26	0,31	0,35
I use a mouth mask where it is obligatory (1.0 = strongly agree; 0.0 = strongly disagree)	0,92	0,89	0,80	0,73
I stay at home if I have symptoms that might indicate a COVID-19 infection and take a test (1.0 = strongly agree; 0.0 = strongly disagree)	0,87	0,88	0,75	0,72

Table 7
Optimal portfolio(s), scenario 2.

Rank	1st	2nd	3rd	4th	5th
Mouth mask obligation in public transport, shops and hospitality industry		X			X
Starting immediately with a booster campaign and starting with vulnerable people	X	X	X	X	X
Advice to work at home, unless it is absolutely necessary	X	X		X	X
Advice higher education online and maximum number of students per college					
Requiring shops to offer time slots for people with vulnerable health					
Limit number of customers per square metre in non-essential shops				X	X
Pick up orders only in non-essential shops					
1/3 capacity and fixed seating at events					
Banning festivals and major sporting events					
Vaccination passport hospitality industry (2G or 3G)					
Vaccination passport for people working with vulnerable people					
Encourage self-testing by making it available free of charge, among other things	X	X	X	X	X
Strict advice not to have more than 2 visitors per day at home					
Reduction of risk	28.7%	32.7%	20.7%	30.7%	34.7%
Probability of being better than minimum portfolio	74.5%	72.5%	68.9%	67.9%	66.9%

pressure reduction of 32.7% and a 74% probability of being better than not choosing any measure. It is clear that scenarios 2 and 3 are very similar in terms of the measures that end up in the five-highest-ranked portfolios.

For scenario 3 the LCCA identified five classes. Participants in Cluster 1 (9% of the sample) advise the government to introduce almost all measures in this scenario. More than 80% of the participants in Cluster 2 (22%) advise the obligation to wear a face mask, starting a booster campaign, strict advice about home working and encouraging self-testing. The majority of participants in Cluster 3 (17%) recommends a mouth mask obligation and strict advice about home working. Limiting the capacity at catering establishments and events, and banning festivals and major sports events are advised by a larger number of participants, rather than starting a booster campaign. Trust in the Minister of Health when it comes to information about COVID-19 is relatively low among members of Cluster 3. More than 60% of the participants in Cluster 4 (26%) advise the obligation to wear a face mask, starting a booster campaign, strict advice about home working and encouraging self-testing. None of the participants recommend the measure that people should only be allowed to collect orders from non-essential shops. The vast majority of participants in Cluster 5 (25%) thinks that the government should not introduce any of the measures in this scenario. This cluster adheres poorly to the mouth mask obligation and the advice to stay at home in case of symptoms. Trust in the Minister of Health when it

comes to information about COVID-19 is relatively low among participants from this cluster. The optimal portfolio(s) presented in Table 9 strongly aligns with the preferences of Clusters 2 and 4. Women are relatively strongly represented in Clusters 2 and 3, the clusters that are relatively positive about limiting the capacity at catering establishments and events, and banning festivals. Young people and people who estimate that they run a low risk of becoming ill after a COVID infection are relatively strongly represented in Cluster 5, which recommends hardly any measures. Elderly people and people who think they have a high risk of becoming ill after a COVID infection are relatively strongly represented in Clusters 1 and 2, which are relatively positive about measures in this scenario.

3.2.4. Scenario 4

Finally, under scenario 4 (Table 9), the best package of measures is composed by starting a booster campaign, implementing the advice to work from home, switch to online lessons in the higher education sector and limiting visits at home to two people per day, which results in a risk reduction of the health system becoming overloaded of 34.4% and a 98.9% probability of being better than the minimal portfolio. More restrictive measures are considered in a second or third-best case, such as implementing vaccination passports. Very invasive measures, such as closing schools, bars or restaurants do not end up in the highest ranked portfolios.

For scenario 4, the LCCA identified five classes. The majority of the participants in Cluster 1 (9% of the sample) advise implementing all measures. Similarly, the majority of participants in Cluster 2 (14%) recommend the introduction of all measures except for the closing of schools, which is recommended by half of the participants. Clusters 1 and 2 are very similar in characteristics. Relatively few participants in Cluster 3 (14%) advise measures such as starting a booster campaign,

Table 8

Optimal portfolio(s), scenario 3.

Rank	1st	2nd	3rd	4th	5th
Mouth mask obligation in public transport, shops and hospitality industry	X	X			X
Starting immediately with a booster campaign and starting with vulnerable people	X	X	X	X	X
Advice to work at home, unless it is absolutely necessary	X	X	X	X	
Advice higher education online and maximum number of students per college					
Requiring shops to offer time slots for people with vulnerable health					
Pick up orders only in non-essential shops					
1/3 capacity and fixed seating at events					
Banning festivals and major sporting events					
Vaccination passport hospitality industry (2G or 3G)					
Vaccination passport for people working with vulnerable people					
Encourage self-testing by making it available free of charge, among other things	X		X		X
Strict advice not to have more than 2 visitors per day at home					
Lockdown after 8pm					
Reduction of risk	32.7%	24.7%	28.6%	20.7%	24.6%
Probability of being better than minimum portfolio	73.9%	71.3%	69.6%	67.0%	66.7%

Table 9

Optimal portfolio(s), scenario 4.

Rank	1st	2nd	3rd	4th	5th
Starting immediately with a booster campaign and starting with vulnerable people	X	X	X	X	X
Advice to work at home, unless it is absolutely necessary	X	X	X	X	X
Advice higher education online and maximum number of students per college	X	X	X	X	X
Lockdown after 5pm or 8pm					
Pick up orders only in non-essential shops					X	
Vaccination passport hospitality industry (2G)*			X		X
Vaccination passport for people working with vulnerable people		X	X		
Closing restaurants/cafés*					
Closing sports venues*					
Strict advice not to have more than 2 visitors per day at home	X	X	X	X	X
Closing cinemas, concert halls and theatres*					
Closing primary and secondary schools					
Reduction of risk	34.4%	41.0%	48.1%	37.3%	41.4%
Probability of being better than minimum portfolio	98.9%	99.0%	98.7%	98.6%	98.6%

*Part of the minimum portfolio.

strict advice about homeworking and advising higher education to teach online. Contrastingly, relatively many participants advise measures that considerably restrict people's freedom, such as closing restaurants. Relatively speaking, many participants of Cluster 4 (30%) recommend

measures such as starting a booster campaign, strict advice about homeworking and advising higher education to teach online, and relatively few recommend severe measures such as closing restaurants and schools. Cluster 4 is also negative about the COVID certificate. Young people are strongly represented in this cluster, the trust in the Outbreak Management Team is low and the booster rate is relatively low at 44%. In terms of preferences, Cluster 5 (33%) is very similar to Cluster 4, but people are more positive about the COVID certificate and more negative about closing sectors such as schools and sports venues. Compared to Cluster 4, older people are much more strongly represented in this cluster than younger people. People who (strongly) agree with the statement that the COVID-19 crisis has limited them in how they want to live their lives are also strongly represented in Cluster 5. The optimal portfolios align best with the preferences of the members of Clusters 4 and 5.

3.3. Participants' experiences

The essence of a PVE is that citizens step into the shoes of a policy-maker which entails that they have to complete a complex choice task. Although respondents are assisted with an instruction video and the PVE is made accessible for low-literate citizens through a language check, it can be questioned whether lay citizens are able to make such choices. To verify how respondents experienced the PVE, we asked them to rate four statements (see Table 10). 81% of the respondents said that they were confident about their choices in the PVE and 73% said that they found the PVE a good method to involve citizens in COVID-19 decision-making. 62% said that their acceptance of COVID-19 policies increased when the government involved many citizens in COVID-19 policy making via the PVE.

A final result of our study is that 22% of the participants thought that the advice given by citizens in the PVE should have a heavier weighting in the government's decision-making than the advice given by experts. Conversely, 44% of participants opined that the expert advice should weigh heavier and 34% said that citizens' advice and expert advice should have equal weighting. This deviates considerably from the previous COVID-19 consultation (Mouter et al., 2021a, b) in which 5% said that citizens' advice should have a heavier weighting and 69% said that expert advice should have a heavier weighting.

4. Discussion

This study investigated citizens' preferences towards imposing measures in four scenarios of the COVID-19 pandemic that can unfold

Table 10

Answers to four statements about experiences of the PVE experiment (Study 1).

	Fully agree	Agree	Neutral	Disagree	Fully disagree
I am confident about my choices	33%	48%	15%	3%	2%
I think that this consultation provided me with enough information to provide advice to the government	21%	46%	26%	4%	3%
This is a good method to involve citizens in the COVID-19 policies of the Dutch government	31%	42%	21%	3%	3%
My acceptance of COVID-19 policies increases when the government involves a large group of citizens in COVID-19 policies via this consultation.	22%	40%	29%	6%	3%

after the Omicron wave of the COVID-19 pandemic: 1) spring/summer scenario with low number of hospitalizations; 2) autumn/winter scenario with higher number of hospitalizations; 3) a new contagious variant. The impact on hospitalizations is unclear; 4) a new contagious variant. Hospitalizations will substantially increase. Moreover, we examined which risk levels in terms of the health system becoming overloaded are acceptable to citizens in each of the scenarios and whether preferences differ among subgroups in the population.

4.1. Main conclusions

We find that the majority of the respondents thinks that in scenario 1, with low numbers of hospitalizations, hygiene measures such as not shaking hands and staying at home in case of COVID-19 symptoms should remain. Moreover, we find that citizens' preferences for COVID-19 measures hardly differ between scenarios 2 and 3. In both scenarios, citizens prefer the obligation to wear a face mask in public transport, shops and restaurants, starting a booster campaign, strict advice to work from home and encouraging self-testing. In both scenarios, young respondents are more willing than older respondents to accept more risks of the health system becoming overloaded. A finding that is consistent with other studies (Gotanda et al., 2021; Levitt et al., 2022). Moreover, in these scenarios, individuals who felt at high risk of becoming ill after a COVID-19 infection, and individuals expressing high confidence in information about COVID-19 from government institutions, are relatively positive about COVID-19 restrictions. This resembles findings in French and German preference elicitation studies (Krauth et al., 2021; Sicsic et al., 2022).

In scenario 4, in which hospitalizations will substantially increase, measures that severely restrict people's freedom, such as closing schools, bars and restaurants, are not supported by a majority of the population. The findings of our study - that citizens prefer a continuation of low-impact preventive measures in the low risk scenario 1 and at the same time are hesitant about the implementation of severe measures in the high risk scenario 4 - echoes the findings of Krauth et al. (2021) that German citizens are sceptical about the implementation of severe measures and at the same time cautious towards extensive re-opening strategies.

Finally, our paper provides a methodological contribution in the sense that we establish that COVID-19 measures are ranked similarly when citizens actively provide advice when in the role of a policy maker (Study 1) and when participants are asked which measures they would find acceptable if the government were to implement them (Study 2).

4.2. Limitations

The primary limitation is that our study is confined to the Dutch context and it is unclear to which extent our study can be generalized to other countries. Loría-Rebolledo et al. (2022) argue that preferences can vary substantially across countries that are relatively similar in terms of culture and vaccination rate, as they find that British citizens were willing to accept a higher increase in excess deaths to have less strict lockdown restrictions introduced, compared with Scotland, Northern Ireland and Wales, respectively. Moreover, it is unclear whether our results can be generalized to other stages in the pandemic, such as a stage in which a severe variant becomes dominant. Perhaps, the preferences for severe measures in scenario 4 would become more favourable when people witnessed hospitals becoming overloaded in real-life. Hence, to verify the generalizability of our study, we recommend re-administrating our study in different countries and in different stages of the pandemic.

A second limitation of our study is that we used an online sample which may have resulted in a relatively low participation of digitally less literate people. However, a Dutch study that compared a paper-based and an online-based DCE found no evidence of inferior results in the online version (Determann et al., 2017). Hence, we assume that if we

had used a paper-based administration method, we would have found similar results overall.

4.3. Policy implications

The results suggest that policies that focus on prevention (through advising low-impact hygiene measures) and early response to moderate threats (by scaling up to moderately restrictive measures and boostering) can count on substantial support. There is low support for lockdown measures even under high-risk conditions, which further emphasizes the importance of prevention in a low-risk scenario and a timely response to new threats.

Because preferences hardly differ between scenarios 2 and 3, we suggest that the Dutch government should perhaps merge these scenarios in their COVID-19 strategy. The autumn/winter scenario could be set in motion when a new contagious variant is identified in another country, but the impact on hospitalizations is still unclear. Our study provides insight for policy decisions on acceptable risk levels and measures to impose in different COVID-19 scenarios and our subgroup analyses can be used to identify, and potentially resolve, conflict between classes of the population about policy decisions. When the government decides to implement (a range of) COVID-19 measures in a particular scenario, the LCCA results can assist to identify which subgroups in the population will particularly resist this decision, which will allow the government to target their communication strategy and/or implement mitigating measures. More specially, our results show that low-educated people, people out of work due to the pandemic and people who have run into financial problems due to the crisis are overrepresented in the extreme clusters that either reject COVID-19 measures or favour very strict COVID-19 policies. Socioeconomic differences in adherence were also reported in various previous studies (Dempster et al., 2022; Pak et al., 2021) This can urge the government to particularly target communication strategies and mitigation measures towards these groups, which is of even more importance in the case of imposing stricter measures (Pak et al., 2021). Moreover, we recommend that the government should particularly target young citizens in their communication about the desirability of COVID-19 measures, as younger citizens were relatively hesitant about implementing COVID-19 measures.

Author Contributions

Niek Mouter: Conceptualization, Methodology, Supervision, Analysis and interpretation, Drafting of the manuscript. Karen Trujillo Jara: Methodology, Analysis and interpretation, Drafting of the manuscript. Jose Ignacio Hernandez: Methodology, Analysis and interpretation, Drafting of the manuscript. Maarten Kroesen: Methodology, Analysis and interpretation, Drafting of the manuscript. Martijn de Vries: Conceptualization, Methodology, Analysis and interpretation, Drafting of the manuscript. Tom Geijsen: Conceptualization, Methodology, Analysis and interpretation, Data Curation, Drafting of the manuscript, Floor Kroese: Conceptualization, Methodology, Interpretation, Drafting of the manuscript, Ellen Uiters: Conceptualization, Methodology, Interpretation, Drafting of the manuscript. Marijn de Bruin: Conceptualization, Methodology, Interpretation, Drafting of the manuscript.

Data availability

The raw data will be made available after publication

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2022.115430.

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