ORIGINAL RESEARCH ARTICLE

Exploring the Trade-Off Between Economic and Health Outcomes During a Pandemic: A Discrete Choice Experiment of Lockdown Policies in Australia

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Abstract

Background All countries experienced social and economic disruption and threats to health security from the COVID-19 pandemic in 2020, but the responses in terms of control measures varied considerably. While control measures, such as quarantine, lockdown and social distancing, reduce infections and infection-related deaths, they have severe negative economic and social consequences.

Objectives The objective of this study was to explore the acceptability of different infectious disease control measures, and examine how respondents trade off between economic and health outcomes.

Methods A discrete choice experiment was developed, with attributes covering: control restrictions, duration of restrictions, tracking, number of infections and of deaths, unemployment, government expenditure and additional personal tax. A representative sample of Australians ($n = 1046$) completed the survey, which included eight choice tasks. Data were analysed using mixed logit regression to identify heterogeneity and latent class models to examine heterogeneity.

Results In general, respondents had strong preferences for policies that avoided high infection-related deaths, although lower unemployment and government expenditure were also considered important. Respondents preferred a shorter duration for restrictions, but their preferences did not vary significantly for the differing levels of control measures. In terms of tracking, respondents preferred mobile phone tracking or bracelets when compared to no tracking. Significant differences in preferences was identified, with two distinct classes: Class 1 (57%) preferred the economy to remain open with some control measures, whereas Class 2 (43%), had stronger preferences for policies that reduced avoidable deaths.

Conclusions This study found that the Australian population is willing to relinquish some freedom, in the short term, and trade off the negative social and economic impacts of the pandemic, to avoid the negative health consequences.

1 Introduction

The unprecedented global disruption caused by the COVID-19 pandemic triggered catastrophic economic and social disorder, and threatened health security [1–3]. To contain the disease, and reduce morbidity and mortality, most governments imposed strict travel and social distancing restrictions. Internationally, three broad strategies emerged: elimination, reducing infection rates to manageable levels and herd immunity [2, 4, 5]. In Australia, policies aimed at reducing infection rates (known as 'flattening the curve') were

initially imposed to slow disease transmission, and reduce the burden on the health system [6]. The initial success of this policy led to a longer term policy aimed at infection elimination [7, 8].

Historically, quarantine, lockdowns and social distancing measures have previously been used to minimise infectious disease transmission [9]. At the beginning of the COVID-19 pandemic, restrictions were based on limited information and uncertainty about the pathogenicity of the SARS-CoV-2 virus. In Australia, international borders were closed to all non-residents, returning residents were requested to self-isolate, and then later required to quarantine in a hotel for 14 days (with the Australian Government covering the cost) [10]. Non-essential services ceased operation and schools switched to online learning, with most children encouraged to home school [11, 12]. Restrictions were placed on social gatherings, and guidelines and rules to ensure social

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Key Points

The experience internationally of the COVID-19 pandemic has shown that decision makers must balance the control of infection with the economic and social consequences of restrictions. It is important to understand the population's willingness to make these trade-offs. Understanding community preferences can inform responsive government policy. Policies that reflect the population's values and attitudes are more likely to receive acceptance and have better compliance.

By investigating these preferences through a discrete choice experiment, we have found that the Australian population is willing to accept restrictions with negative economic and social consequences and relinquish some freedom, in the short term, to avoid the negative health consequences of a pandemic. Preferences about these trade-offs are not homogenous, and two distinct classes were observed. Class 1 did not have strong preferences but are accepting of medium-level restrictions and the use of tracking bracelets. Class 2 had strong preferences, with the main driver being the desire to avoid deaths, which means that people with these preferences will be accepting of stay-at-home orders.

As the risk of outbreaks of COVID-19 can occur rapidly and result in future waves of infection, policy decision makers may find this study relevant in that people's willingness to accept trade-offs have been shown using these discrete choice experiment methods. These results can help decision makers to frame policy measures to ensure greater acceptance.

distancing were implemented to reduce the risk of transmission [13]. Finally rigorous contact tracing was introduced to manage local outbreaks. As of 24 November, 2020, Australia had reported 27,835 COVID-19 cases and 907 deaths, which is notably lower than many comparable countries [14].

While these measures have been effective in reducing the spread of COVID-19, they have significantly impacted the economy and have led to reduced economic activity, business closures and unemployment. This underscores the challenging balance between managing health risks and maintaining economic outcomes, such as employment and income. Even when the perceived risks of contracting COVID-19 were high, concerns were raised about the economic impact of mandatory lockdown measures, even while they were generally accepted. As the perceived risks decreased, justifying restrictions became more difficult, even

though the risk of a second wave remained, as evidenced in Victoria, Australia [8].

The challenge for policy decision makers is, when and by how much should restrictions be eased or re-imposed? Many countries that have relaxed restrictions have experienced increases in infection. Concerns about "lockdown fatigue" and uncertainty about the availability of the vaccine for COVID-19 have meant governments have introduced policies that try to balance the risks of infection and limits on economic activity. Living a "COVID-normal" life has been proposed [15]. What is the optimal balance between disease control and the economy?

Understanding community preferences can inform responsive government policy. Policies that reflect the population's values and attitudes are more likely to receive acceptance and have better compliance. The aim of this study was to understand the preferences of Australians towards strategies to control the risks of a pandemic. Specifically, the study sought to measure the trade-offs between mass unemployment, restrictions in freedom, and mortality and health risks at a national level and how preferences across individuals and groups might differ.

2 Methods

We designed a discrete choice experiment (DCE) to explore the preferences and the consequences of different control policies during a pandemic.

2.1 Survey Development

Government websites, broadcasting media and websites reporting national statistics for COVID-19 were used to inform the development of attributes [14, 16, 17]. Using these sources ensured the language used to describe attributes would be familiar to respondents, which would aid comprehension.

Attributes and levels were then tested using a focus group comprising experienced researchers ($n = 14$) and a pilot study in a convenience sample of the general population ($n = 84$). In the pilot, no overlap was imposed on the attribute levels. The results from the pilot indicated that respondents understood the attributes selected for inclusion adequately described the national perspective and all attributes were considered in respondent choices.

The full survey contained five sections: (1) demographic questions used for screening; (2) eight choice tasks; (3) questions about the difficulty in completing the choice tasks; (4) attitudinal statements about the risks of COVID-19, control measures and impact on the economy; and (5) questions relating to sociodemographics, labour and employment,

Fig. 1 Example of a choice task

Please consider the two policy options below:

	Policy 1	Policy 2
Restriction level	Level C (High level restrictions)	Level B (Medium level restrictions)
Duration of restrictions	3 months	1 month
Tracking of people	Mobile phone (Everybody with a mobile phone)	Mobile phone (Everybody with a mobile phone)
Number of people infected with disease	50,000	100,000
Total number of deaths	500	5000
Number of people that lose their job	1,500,000	500,000
Additional government spending	$ 200 billion	$ 50 billion
Additional income tax levy for the next 3 years	1%	3%
Which is your preferred policy option?	○	○

self-reported health and experiences during the COVID-19 pandemic.

2.2 General Structure of the DCE

Respondents were given background information, followed by a series of eight choice tasks, each describing two policy options, and were asked to choose their preferred policy. An example of a choice task is presented in Fig. 1. The background information provided context for the DCE. We set the scene by describing a pandemic. Respondents were told there was an infectious disease outbreak and given some information about the consequences of the infection and some general information about measures to reduce transmission. While the context did not specifically mention COVID-19, we considered that, given the gravity of the COVID-19 pandemic and the timing of the survey, respondents would have the COVID-19 pandemic on their mind whilst completing the survey.

2.3 Attributes and Levels

Eight attributes were selected, based on three aspects of the outbreak: control measures, burden of disease and economic consequences. Specifically, the attributes covered: the level of restrictions; duration of the restrictions; how and whether people should be tracked; number of people infected over the course of the pandemic; number of deaths; job losses; government expenditure; and the income tax levy enforced for 3 years after the pandemic. A summary of the attributes and levels are provided in Table 1.

Three attributes described the control measures (restriction level; duration; and tracking). The restriction level attribute is represented in Fig. 2 and describes a number of policies, with Level A being the least restrictive and Level C the most restrictive. Each level was described using restrictions in four areas: mandatory quarantine and self-isolation, staying at home, offices and schools, and stores and services. These were chosen as they impact on the ability of people to work and do their usual activities. Four levels were used to describe the duration of the restrictions, from 1 month to 12 months. Restrictions described in the survey were analogous to restrictions that occurred during the COVID-19 pandemic in Australia [18]. The online survey was constructed such that the definitions of the restriction levels were provided in the choice sets via a rollover embedded on the webpage, where the definition appeared when respondents hovered their cursor.

Tracking of individuals was described by a three-level attribute: mobile phone tracking; tracking bracelet (positive cases and new arrivals); and no tracking (contact tracing only) [6].

At the time of the study, global COVID-19 statistics were reported daily via several websites [14, 16, 17]. Cumulative totals were most typically used to summarise COVID-19 information, therefore respondents were familiar with this reporting method, as confirmed during the focus group. Two attributes described the burden of disease: the number of infections and the number of deaths, each with four levels. The number of infections ranged from 10,000 to 500,000, nationally, and were based on best- and worst-case scenarios [19]. The number of deaths presented ranged from 100 to 5000. The lowest level was based on the number of deaths in

Table 1 Attributes and levels

Theme	Attribute	Levels	A priori expectations
Control measures	Restriction level	Level A (low-level restrictions) Level B (medium-level restrictions) Level C (high-level restrictions)	Lower level restrictions would be preferred over higher level restrictions
	Duration of restrictions	1 month 3 months 6 months 12 months	Negative preferences for duration, with larger decrements as duration of time increases
	Tracking of people	Mobile phone (everybody with a mobile phone) Tracking bracelet (positive cases and new arrivals) No tracking (contact tracing only)	Nil a priori expectations Direction and magnitude of preference is unclear
Burden of disease	Number of people infected with disease	10,000 50,000 100,000 500,000	Negative preferences for the number of people infected, with larger decrements as the number of people increases
	Total number of deaths	100 500 1000 5000	Negative preferences for the number of deaths, with larger decrements as the number of deaths increases
Economic consequences	Number of people who lose their job	500,000 1,000,000 1,500,000 3,000,000	Negative preferences for the number of jobs lost, with larger decrements as the number of jobs lost increases
	Additional government spending	$50 billion $100 billion $200 billion $500 billion	Nil a priori expectations Direction and magnitude of preference are unclear
	Additional income tax levy for the next 3 years	1% 3% 5%	Nil a priori expectations Direction and magnitude of preference are unclear

Base levels: restriction, Level A; duration, 1 month; tracking, no tracking; infections, 10,000; deaths, 100; jobs lost, 500,000; government spend, $50 billion; tax levy, 1%

Fig. 2 Overview of restriction levels
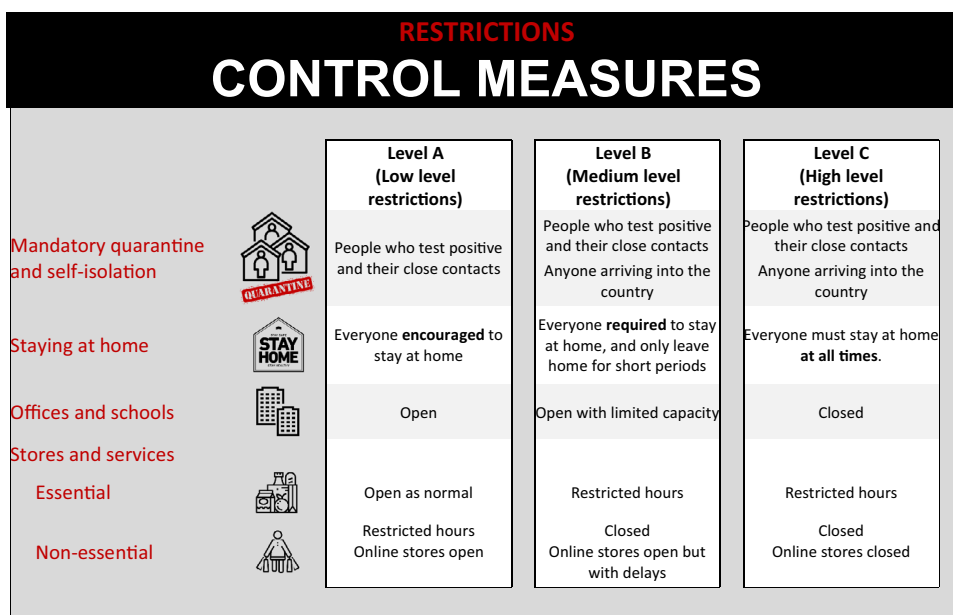
Australia[1] at the time of the survey design. The level for the highest number of deaths was based on worst-case scenarios.

Three attributes were used to describe the economic consequences. There were four levels for the unemployment attribute, from 500,000 to 3,000,000 job losses. These levels were selected based on data from the Australian Bureau of Statistics (approximately 600,000 job losses from March 2020 to April 2020) [20–22], and forecasts from the Grattan Institute [23].

A second four-level attribute was used to describe the government expenditure, which ranged from $50 billion to $500 billion. This was informed by government measures at the time, for example, in April 2020, the Australian Federal Government announced a $130 billion stimulus to preserve productive capacity by funding the JobKeeper payment scheme [12].

Finally, a three-level attribute was used to describe a hypothecated tax, expressed as a percentage of income for 3 years. Although a tax levy was not proposed, tax levies have been used by the Australian Government in response to natural disasters in the past. The income tax levy was included to reflect the additional tax burden from an individual's perspective [24, 25].

2.4 Designed Experiment

The design was constructed to have eight blocks of eight choice sets each. The choice sets were constructed using the L^{MA} approach to ensure that there was an attribute-level overlap within choice sets, both to improve respondent efficiency and to stop individuals from making choices based only on the one attribute on all occasions. The initial design was an orthogonal array with 64 runs [26]. The eight-level attribute defined the blocks and attributes with three levels were obtained from those with four levels by equating 3 to 0. No priors were used in the design.

2.5 Data Collection

Ethics approval was granted by the University of Technology Sydney Human Research Ethics Committee under a Program Ethics Approval (HREC Reference No. ETH18-2507). Data were collected between 14 July and 7 August, 2020. Respondents were recruited using an online panel (Toluna). A small monetary incentive was provided for completing the survey. Quotas based on age, sex and state of residence were applied. State of residence quotas were applied such that at least 300 respondents were included each from New South Wales, Victoria, and the other states/territories in Australia. A large sample from Victoria were recruited owing to a

second wave that was occurring in the state at the time. In total, 1986 respondents, having been invited, started the survey. Of these, 926 respondents were not randomised (over-quota, $n = 370$; consent was not given, $n = 106$; screened out or timed out, $n = 429$) or did not complete at least one choice set ($n = 21$). Fourteen respondents were identified as potential "bots" because their responses to the open text questions were random strings of letters and were excluded from the analysis. Respondents who completed at least one choice set were included in the analysis ($n = 1046$).

2.6 Data Analysis

Data were analysed using Stata software, College Station, TX, Version 15.1. Two methods of modelling were undertaken; mixed logit modelling (MXL) and latent class (LC) logit modelling.

Mixed logit models were estimated using the 'mixlogit' command in Stata, which takes into account the panel nature of DCE data [27, 28]. To obtain the final model, the MXL analyses were conducted in two steps, with the levels for each attribute added as a group of explanatory random parameters in separate models. In total, eight models were estimated. Random parameters that were statistically significant from each model were included as random parameters in the final model (Level C restrictions; 12-month duration; tracking via bracelet; tracking via mobile phone; 500,000 infections; 5000 deaths; $500 billion government spend; 5% income tax levy). Standard errors were clustered by respondent. Each model was simulated using 500 Halton draws. The detailed approach to obtain the final model is described in the Electronic Supplementary Material (ESM). All attributes were dummy coded. The reference levels are: Level A restrictions; 1-month duration of restrictions; no tracking; 10,000 infections; 100 deaths; 500,000 people made unemployed; $50 billion government spend; and 1% income tax levy. These were fixed to zero. The estimated parameters for all other levels refer to the differences from the omitted level.

The LC model assumes there are Q LCs with distinct preferences and predicts the probability of an individual belonging to a specific class [29, 30]. Preferences do not vary within each class; however, preferences vary across the LCs. The LC models [30] were conducted using the 'lclogit2' command in Stata. The optimal number of LCs was determined by comparing the Bayesian Information Criterion [31].

To explore the characteristics of respondents likely to have preferences aligned with each LC, we estimated multinomial logistic regression models using the 'mlogit' command in Stata [32]. In these analyses, respondents were assigned to a LC based on the highest posterior probability based on their choice responses. Class assignment was used

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[1] As of 18 June, 2020, there were 102 deaths reported.

as a dependent variable and respondents characteristics were used as the independent variables.

3 Results

3.1 Respondent Characteristics

The sample demographics are presented in Table 2. Characteristics pertaining to work, household composition and health status are provided in Table 3. The sample is generally representative of the Australian population, although respondents had a higher level of educational attainment than the overall population and a higher proportion were from Victoria.

More than half the sample ($n = 604$, 58%) were employed, and 70% of these indicated they had experienced changes to working conditions ($n = 423$), as a result of the COVID-19 pandemic. Three quarters of the sample indicated they lived with others, with a small proportion ($n = 62$, 6%) reporting an increase in the number of people living in the household since the start of the pandemic. Most respondents reported they were in very good or good health, and approximately a third of the sample reported they had an illness, health problem, condition or disability.

Approximately 12% ($n = 122$) of respondents reported they had experienced specific COVID-19 pandemic-related incidents, for example, being required to self-isolate or being quarantined in a hotel, receiving a police fine or applying for welfare as a result of COVID-19 impacts. Less than half (43%) reported they had downloaded the COVIDSafe® app. The majority (76.2%) of the sample agreed that they considered the whole description whilst completing the tasks, demonstrating they considered the options seriously, and 40% of respondents indicated that they considered all attributes for each policy option.

3.2 Opinions and Attitudes

Most people agreed that the government was quick to respond ($n = 661$) and disagreed that the restrictions that were in place were excessive ($n = 675$) or too costly ($n = 464$) [Table 5 of the ESM]. Most people agreed that Australia's borders should remain closed to international visitors ($n = 828$) and thought the restrictions were eased too quickly ($n = 624$) and were worried about a second wave of COVID-19 cases ($n = 816$).

With respect to the economy, the responses were more mixed. With respect to the risk of being infected or dying, most respondents agreed with the statements "the risk of dying (or being infected) with COVID-19 was high". Results were similar when asked about their attitudes in the past, and their current attitudes.

3.3 MXL Model

Results of the MXL model are presented in Fig. 3 and Table 5 of the ESM. In general, respondents had strong preferences for policies that avoided high infection-related deaths, although lower unemployment and lower government expenditure were also considered important.

Respondents preferred a shorter duration for restrictions, with larger negative and statistically significant coefficients for a duration of restrictions lasting 6 or 12 months. Preferences did not vary significantly for the particular levels of control measures. The coefficients of the restrictions were not statistically significant for either Level B or Level C restrictions (Fig. 2). That said, the MXL model indicated that there was significant unobserved heterogeneity in the most stringent restriction level (Level C) when compared with Level A ($p < 0.001$).

Respondents preferred people (positive cases and new arrivals) to be tracked with a tracking bracelet compared with no tracking ($p < 0.01$) and via a mobile phone compared with no tracking ($p < 0.05$). Heterogeneity was observed with both levels ($p < 0.001$).

For the remaining attributes, the results were ordered as expected with larger negative coefficients being observed as the numerical values increased. All coefficients for all attribute levels were statistically significant compared with the base levels under these domains of burden of disease and economic consequences. In particular, respondents had strong preferences to avoid infections and deaths.

3.4 LC Analysis

The LC analysis identified two distinct classes (Table 5 of the ESM and Fig. 4); and model fit statistics are provided in Table 4 of the ESM. In class 1 (share 57%), the only statistically significant coefficients were those associated with level B restrictions (preferred to level A restrictions; $p < 0.01$), with tracking bracelets (preferred to no tracking; $p < 0.001$), with 500,000 deaths (less acceptable than 10,000 deaths, $p < 0.01$) and with either 5% ($p < 0.001$) and 3% ($p < 0.05$) tax levies (compared to a levy of 1%).

Four coefficients were not statistically significant in class 2 (share 43%) [level B restrictions; 3 months duration; and tracking using a bracelet or mobile phone]. All other coefficients were statistically significant. For the other coefficients, tighter restrictions as described in Level C were less preferred than those described in Level A ($p < 0.05$); restrictions lasting 6 months were less preferred than those lasting 1 month ($p < 0.001$); and respondents strongly preferred that restrictions not be in place for 12 months compared with 1 month ($p < 0.001$). Class 2 had strong preferences against policies that resulted in a high burden of disease, with the

Table 2 Demographics: comparison of respondents and the Australian population Source: ABS [45–48]

n (%)	Respondents (n = 1046)	Australian population, %
Age[a], years		
18–24	132 (12.62)	12.2
25–34	196 (18.74)	19.3
35–44	176 (16.83)	17.3
45–54	173 (16.54)	16.8
55–64	160 (15.3)	14.8
65 and over	209 (19.98)	19.6
Sex[a]		
Female	526 (50.29)	50.9
Male	516 (49.33)	49.1
Other/prefer not to say	4 (0.38)	NR
Residential state in Australia[a]		
Australian Capital Territory	33 (3.15)	1.7
New South Wales	346 (33.08)	32.0
Northern Territory	3 (0.29)	1.0
Queensland	156 (14.91)	19.8
South Australia	71 (6.79)	7.2
Tasmania	22 (2.1)	2.2
Victoria	347 (33.17)	25.7
Western Australia	68 (6.5)	10.5
Country of birth, Australia[b]		
Australia	767 (73.33)	73.5
Aboriginal and/or Torres Strait Islander[b]	67 (6.41)	2.8
Highest level of education completed[c]		
Year 11 or below	107 (10.23)	23.0
Year 12	158 (15.11)	18.3
Post-high school qualification (trade certificate/ diploma)	268 (25.62)	27.2
Bachelor's degree	318 (30.4)	18.6
Higher degree	160 (15.3)	9.8

ABS Australian Bureau of Statistics, *NR* Not reported

[a]Data obtained from the ABS for comparison have been adjusted by age. The basis of the percentages presented for the Australian population was adjusted to exclude the population that is below the age of 18 years to allow for a comparison with the sample set

[b]Data obtained from the ABS have not been adjusted by age

[c]Data obtained from the ABS include the highest education attainment for people aged between 15 and 74 years

largest decrements being for the highest infection-related death compared with additional government spending.

Younger respondents (below the age of 25 years), and those who report self-rated health as excellent were more likely to have Class 1 preferences, whereas older respondents (over the age of 45 years) and those who report self-rated health as poor were more likely to have Class 2 preferences. Respondents who had at least one direct experience with COVID-19 restrictions, including being required to self-isolate or quarantine for being identified as a close contact with a case, or on return from overseas travel, being issued a fine from the police, or applying for welfare because of COVID-19, were more likely to have Class 1 preferences.

As part of the full survey, respondents were asked about their opinions and attitudes about the government's response to the pandemic and the restrictions used. Class 1 were more likely to agree that social distancing, isolation and quarantine measures were excessive and that the impact of the restrictions were too costly, whereas Class 2 were more likely to strongly disagree with these two statements.

Table 3 Other characteristics of the respondents

| n (%)	Respondents (n = 1046)
Work status	
Employed 35 h or more per week (including self-employed and working students)	393 (37.57)
Employed less than 35 h per week (including self-employed and working students)	211 (20.17)
Not employed but looking for work	88 (8.41)
Retired	210 (20.08)
Home duties (not looking for work)	69 (6.6)
Non-working student	33 (3.15)
Changes in working conditions	
Work hours reduced	263 (25.14)
Work hours increased	54 (5.16)
Wage/salary reduced	110 (10.52)
Increased work hours on current wage/salary	28 (2.68)
Job loss/business closure	48 (4.59)
Stood down/forced to take unpaid leave	43 (4.11)
Applied for financial aid/welfare (e.g. JobKeeper, JobSeeker)	58 (5.54)
Still employed but required to work from home	128 (12.24)
Required to take paid leave entitlements (e.g. annual leave, long service leave)	18 (1.72)
No changes	515 (49.24)
Household composition	
Lives alone	235 (22.47)
Lives with others	776 (74.19)
No changes in household due to COVID-19 pandemic	
No	926 (88.53)
Yes—more people live in the household now	62 (5.93)
Yes—fewer people live in the household now	23 (2.2)
Self-rated health	
Excellent	159 (15.2)
Very good	319 (30.5)
Good	349 (33.4)
Fair	142 (13.6)
Poor	32 (3.1)
Any illness, health problem, condition or disability	343 (32.8)
Experience with COVID-19	122 (11.7)
Have you or someone in your family received a COVID-19 diagnosis?	62 (5.9)
I was required to self-isolate because I was a close contact of someone who had contracted COVID-19	83 (7.9)
I was required to self-isolate because I returned from travelling overseas	63 (6.0)
I was quarantined in a hotel because I returned from travelling overseas	50 (4.8)
I was issued a fine from the police	46 (4.4)
I applied for financial aid/welfare due to COVID-19	146 (14.0)
Did you download the COVIDSafe app?	450 (43.0)

4 Discussion

We explored the acceptability of different infectious disease control measures during the COVID-19 pandemic in Australia. We examined how respondents trade off amongst restrictions in freedom, mass unemployment and economic and health outcomes. We found that policies resulting in a high death toll were less acceptable than policies resulting in high unemployment, requiring high government expenditure or a high tax levy. Our results suggest that policies returning society to a COVID-normal level could be implemented and may be possible when preferences are taken into account. However there were clear preferences for shorter durations for restrictions. To curb the COVID-19 spread, the state of Victoria had a lockdown that lasted approximately 4 months, from July to October 2020 [33], which is in between two

Fig. 3 Mixed logit model (*n* = 1046). Random parameters: Level C restrictions; 12-month duration; tracking via bracelet; tracking via mobile phone; 500,000 infections; 5000 deaths; $500 billion government spend; 5% income tax levy. Base levels: restriction, Level A; duration, 1 month; tracking, no tracking; infections, 10,000; deaths, 100; jobs lost, 500,000; government spend, $50 billion; tax levy, 1%. *CI* confidence interval
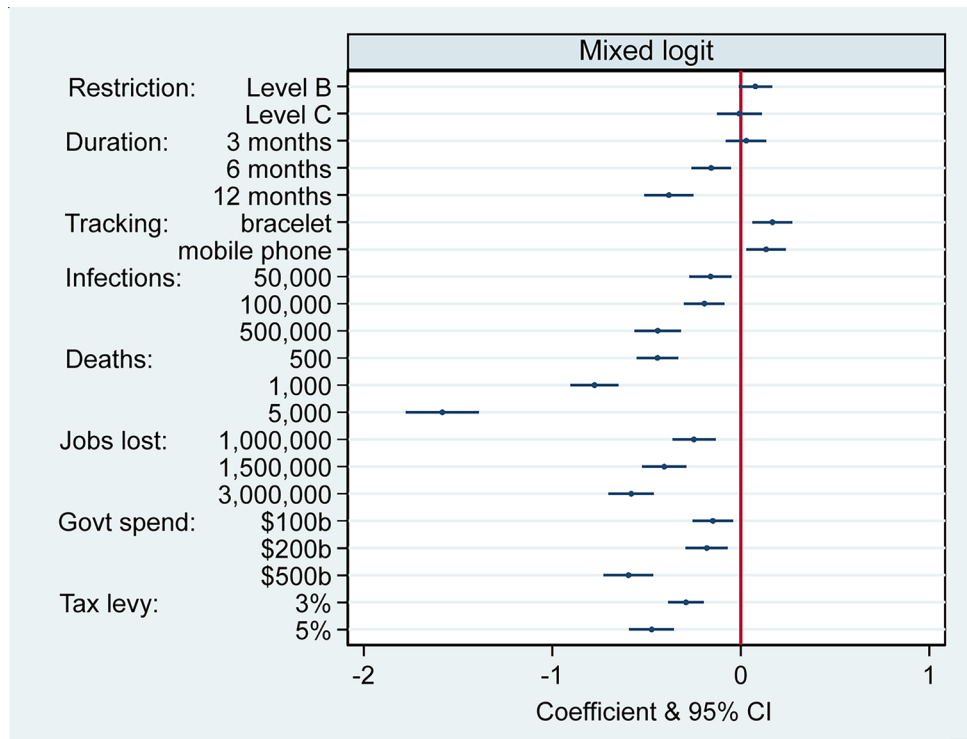
Fig. 4 Latent class analysis (LCA), two classes (*n* = 1046). Base levels: restriction, Level A; duration, 1 month; tracking, no tracking; infections, 10,000; deaths, 100; jobs lost, 500,000; government spend, $50 billion; tax levy, 1%. *CI* confidence interval
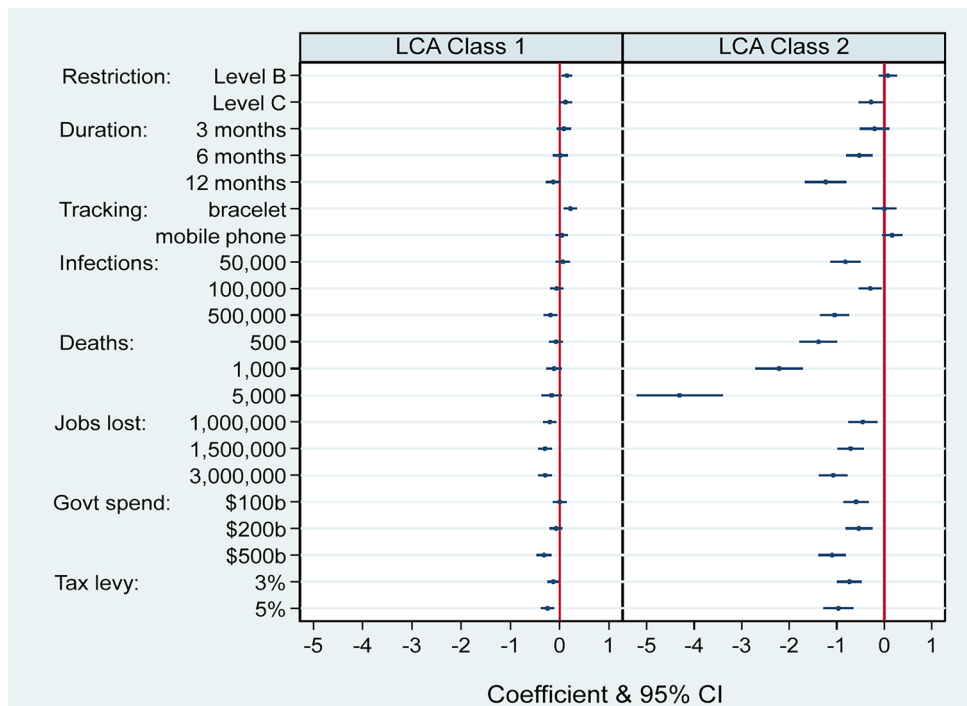
of the levels used for the duration of restrictions in this DCE. Respondents were indifferent to restrictions lasting 3 months; however, restrictions extending beyond 6 months were less desirable.

The COVID-19 pandemic forced the public to change their social behaviours, usual activities and impacted on the ability to work. Social distancing restrictions also reduced the production of goods and services. While there has been much discussion in the media internationally that the community finds the impact of restrictions unacceptable, in our study, we found a higher level of restrictions did not necessarily translate into less acceptance. In the LC analysis, we

found two distinct classes. Class 1 preferred medium-level (Level B) restrictions over low-level (Level A) restrictions ($p < 0.01$). This finding suggests that respondents may value the protection afforded by restrictions and accept that some freedom may be lost in a pandemic with high levels of morbidity and mortality.

The attribute for tracking people yielded interesting results as electronic methods were preferred over no tracking. Concerns about data protection and privacy concerns have been raised as electronic methods require information to be digitally collected, and sensitive information can be easily transferred and is re-identifiable [34–37]. Sabat et al. [3] found that the use of mobile phone tracking to contain disease were one of the more divisive polices used in Europe. Tracking via an electronic device was used for a variety of purposes during the COVID-19 pandemic, for example, devices were used to encourage physical distancing, to monitor a person's vital signs (data are transmitted to a laboratory for further investigation) or to monitor people under quarantine. In Western Australia, people who were non-compliant with quarantine and isolation measures were tracked and fitted with a wearable electronic device under *the Emergency Management Amendment (COVID-19 Response) Bill 2020* [6, 38, 39]. Erosion of legislative protections has also been raised as a concern with the implementation of electronic tracking technology [34]. The powers given to security agencies to stop the movement of people include detaining and monitoring individuals [39], and there are concerns about these powers remaining in place once the pandemic is over [38]. In our survey, open text field comments indicated that some respondents had strong aversions to tracking; however, overall, the results suggested that there were preferences for people to be tracked using an electronic device compared with no electronic device. This shows in Australia there is an acceptance of polices towards using mobile phone and wearable devices to manage and contain disease spread. In implementing these policies, the ability of the government to provide transparency and communicate to the public how data will be used and stored and when it will be destroyed are essential factors that would help to allay concerns people may have about mass surveillance and individual anonymity.

COVID-19-related infections and deaths have often been presented using linear and logarithmic scales [14, 17]. The way in which the number of COVID-19 related deaths is presented has been found to influence policy preferences [40]. In our study, attributes for both the burden of illness and economic consequences were presented using absolute values. We considered that presenting absolute values would be easier to understand when making trade-offs between the attributes. Romano et al. [40] found respondents were better able to understand the impact of COVID-19 on deaths when information was presented on a linear scale compared

to a logarithmic scale. Respondents who were shown linear scales were also more concerned about mortality due to COVID-19 [40]. In our study, we found that respondents were concerned about the economic consequences but were willing to relinquish freedoms during a pandemic with severe health outcomes.

Differences in preferences were revealed in the LC analysis. Class 1 did not have strong preferences or they preferred for the economy to remain open albeit with some control measures in place, whereas Class 2 had stronger preferences to avoid deaths when compared with negative economic consequences. Class 1 preferred policies with medium-level restrictions, where the economy is open with limited capacity, and tracking bracelets are used. Class 1 were indifferent to the duration of restrictions being implemented. Interestingly, deaths were not significant for Class 1. Class 1 were more likely to include respondents below 25 years of age and those in better health. Class 2 were concerned about the economic consequences of people losing their jobs, increasing government spend and additional income tax levies; however, the number of deaths had the largest influence on their preferences. Class 2 were likely to include older respondents (aged older than 45 years) and those in poorer health.

There are two DCEs that have been recently published [41, 42] that examined preferences for the easing of restrictions used to manage the COVID-19 pandemic in the USA [42] and the Netherlands [41]. These are not directly comparable to our study as they differ in terms of the perspective and the attributes and levels used. Lockdown restrictions, cultural influences and disease burden measures such as the number of infections and deaths are quite different across countries. All three studies collected data over a similar time period (between the period April to August 2020).

There are some limitations of this study. This DCE was designed in the early months of the COVID-19 pandemic (April to May 2020). As new information emerged, restrictions had changed in line with recommendations being issued. For example, in Australia, mask usage was not commonplace in May 2020. However, wearing masks was recommended and made mandatory in Victoria in July 2020 to prevent COVID-19 transmission [43]. Information on whether people had been tested was also not collected. Preferences relating to mask usage and testing were not assessed in this study. The level of restrictions in place across Australia varied at the time the survey was undertaken. This survey was initially launched whilst level 3 restrictions were in place in the state of Victoria, but while the survey was in the field, level 4 restrictions were commenced; and curfews were implemented (on 2 August, 2020). The preferences expressed in the study may well be informed by the level of restrictions in place at the time. Given data for this study were collected 5 months after restrictions had commenced, the results of this study are applicable to preferences in the

short term; however, the results may not hold in the long term when lockdown fatigue may be more apparent. It may be worthwhile to repeat this study at a later date.

This study was originally conceived as restrictions were coming into place, and data collection commenced when COVID-19 was largely under control across most of Australia (except Victoria). At the commencement of the COVID-19 pandemic, Australia used the 'flatten the curve' strategy to manage COVID-19, where the objective was to slow transmission such that hospitals were not overwhelmed. To be successful, the public had to engage in a lockdown. At the time of writing this paper (November 2020), Australia had almost eliminated COVID-19 infections with fewer than 1000 deaths in total, which is notably lower than many comparable countries. Australia had been successful in 'flattening the curve'. However, the experience is quite different for other countries, where variant strains of COVID-19 have been identified and are more infectious. In the UK, hospitals have been overwhelmed where one in 50 people have been infected with COVID-19 [44]. Although this study was conducted in Australia, where community transmission has been low, results are relevant to other geographical regions as trade-offs between health and economic consequences have been a feature of the political landscape of lockdown policies worldwide, and coming into 2021, COVID-19 remains in the headline news internationally.

The choices we asked respondents to make were complex, reflecting the challenges the pandemic has created for society. Preferences in this study were conditioned by the respondent's collective experience with restrictions during the first wave, and respondents understanding of what was being traded. Outbreaks of COVID-19 have intermittently flared throughout 2020 and early 2021 in Australia, with clusters being identified in several states at different times, and in responding to these outbreaks, Australian state governments have implemented various restrictions to control disease spread. Successful disease control still requires acceptance of restrictions, and consideration of the trade-offs between health, economic and social consequences for subsequent waves. The results of the DCE show there is an alignment between what the public were willing to endure and what they have been compelled to endure.

5 Conclusions

By exploring stated preferences in the DCE, it appears that the Australian population is willing to accept restrictions with negative economic and social consequences and relinquish some freedom, in the short term, to avoid the negative health consequences of a pandemic. Two distinct classes with significant differences in preferences were identified.

Clear strong preferences were observed in Class 2, with the main driver being the desire to avoid deaths, which means that people with these preferences will be accepting of stay-at-home orders. Although Class 1 did not have such strong preferences, they appear to be accepting of medium-level restrictions and the use of tracking bracelets.

Clusters may potentially appear and be spread by travellers who are unaware that they are contagious and more virulent strains have started to emerge internationally. Even with stringent measures, such as 'hotel quarantine' in place, new arrivals coming into the country through trade or repatriation means that an outbreak is a risk that we may need to live with. Clusters appearing in remote, regional or rural areas may potentially be more devastating, given health services in these areas are harder to access. As the risk of outbreaks of COVID-19 can occur rapidly and result in future waves of infection, policy decision makers may find this study relevant in that people's willingness to accept trade-offs have been shown using these DCE methods.

Declarations

Conflicts of Interest/Competing Interest Kathleen Manipis, Deborah Street, Paula Cronin, Rosalie Viney, and Stephen Goodall have no conflicts of interest that are directly relevant to the content of this article.

Ethics Approval Ethical approval for this study was obtained from the University of Technology Sydney (UTS), Human Research Ethics Committee (HREC) under the Centre for Health Economics Research and Evaluation Program Ethics Approval (UTS HREC Reference number: ETH18-2507).

Consent to Participate Prior to commencing the survey, consent was obtained from all participants.

Consent for Publication Not applicable.

Availability of Data and Material The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

Code Availability The code generated used to analyse the current study are available from the corresponding author on reasonable request.

Authors' Contributions KM, DS, PC, RV and SG developed the research question, methodology and the design of the study. DS constructed the designed experiment. KM performed the data analysis. All authors contributed to the interpretation of the results, the writing of the manuscript and approved the final version for publication.

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