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Aversion to income, ethnic, and geographic related health inequality: Evidence from Australia

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ABSTRACT

This study investigated the Australian general public's views on trade-offs between reducing health inequalities and improving total health. It elicited relative equity weights, comparing inequalities in life expectancy at birth across three equity-relevant dimensions: income (comparing poorest versus richest fifth), ethnic (comparing Indigenous versus non-Indigenous), and geographic (comparing rural/remote versus major cities). A benefit trade-off exercise was administered via online survey to a sample of Australian adults (n = 3105) using quota sampling to ensure population representativeness across key demographic variables (age, gender, state of residence, household income and education level). When comparing income groups, 88% (95% Confidence Interval (CI): 82%–92%) of the respondents were health inequality averse, with 42% (95% CI: 34%–51%) demonstrating extreme inequality aversion. When considering Indigenous status, 85% (95% CI: 79%–90%) showed inequality aversion, and 40% (95% CI: 31%–49%) displayed extreme aversion. Lastly, looking at different geographic locations, 74% (95% CI: 66%–80%) of the respondents were inequality averse, with 37% (95% CI: 29%–46%) showing extreme inequality aversion. The relative equity weights were calculated, allowing for varying baseline inequalities in life expectancy – proportional gaps of 10.8%, 5.1% and 6.3%, respectively. The results imply that the public is willing to weight incremental health gains to the poorest fifth five times more than to the richest fifth, six times more for Indigenous versus non-Indigenous, and four times more for people living in rural and remote areas compared to major cities.

1. Introduction

Health inequalities remain a pervasive issue in both developed and developing countries, significantly impacting population wellbeing, and posing challenges for public health systems.

Two primary goals of health care priority setting are improving overall health and reducing health inequalities between socially advantaged and disadvantaged groups (Whitehead, 1991). Sometimes, these goals conflict with each other, and this conflict is increasingly being addressed in studies that aim to measure both the overall health benefits of interventions and their effects on health inequality (Cookson et al., 2021a, 2021b). However, balancing both objectives systematically and transparently can be challenging.

Health inequality aversion parameters are tools that can help to address this challenge by quantifying the extent to which a group of individuals (e.g. society, or policymakers) is willing to trade off overall health benefits to achieve a more equitable distribution of health. They assist in priority setting and can be used in health-care decision making either implicitly or explicitly (Costa-Font and Cowell, 2019). The implication is that not all health gains are valued equally, and health gains to doubly disadvantaged individuals who are both more socially disadvantaged and less healthy may be given greater importance. Different parameter values thus imply different sets of "equity weights" that adjust the value of health outcomes based on their distributions. Eliciting these parameters can be done using a range of different methods, and the simplest and most widely used approach – which we also adopt in this paper – is to use a single parameter group-level Health-Related Social Welfare Functions (HRSWFs), either using the Atkinson index of relative inequality aversion, based on the parameter ε, or the Kolm index of absolute inequality α. ε represents the degree of

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concern for reducing health inequality rather than increasing total health. This dual perspective helps inform policy decision by offering insights into whether interventions should prioritize reducing proportional differences or closing absolute gaps of health outcomes. As ε increases, the aversion to health inequality increases, attaching more weight to health improvements for those at the lower end of the distribution (i.e.groups with worse health). When ε is equal to 0, it indicates no inequality concerns and when $\varepsilon \to \infty$, it represents an extreme case of aversion to health inequality and an exclusive concern with the worst-off group. The Atkinson index enables the incorporation of distinct degrees of sensitivity to inequalities across different sections of the health distribution. The Kolm index (α) is interpreted similarly to the Atkinson index (ε) but in the context of absolute inequality. A higher value of the Kolm index means that small absolute differences among individuals are given more importance, and policy interventions will prioritize reducing these disparities. A lower α suggests that society tolerates greater absolute differences in health outcomes, placing less importance on policies that focus exclusively on reducing absolute gaps. Redistributive policies would be more aggressive in a society with a high α, as the goal would be to ensure more equal absolute health outcomes (Kolm, 1975).

The traditional approach to eliciting health inequality aversion involves a benefit trade-off exercise, on a gain basis, focusing on the additional health benefits that individuals or groups receive, or outcome basis, considering the overall level of health achieved by each group. It looks at inequalities in terms of different health measures (e.g. quality adjusted life expectancy, life expectancy at birth, years with a health problem) attributed to different groups (McNamara et al., 2020). This is an area of ongoing methodological development and controversy, however, and new methodologies have recently been developed based on social welfare functions with two or more normative parameters, which distinguish "pure" health inequality aversion (Robson et al., 2024) from preferences relating to the priority accorded to specific groups, such as those defined by income level or a specific health condition. We use the traditional single-parameter approach in this study, because its limitations are relatively well understood, and it facilitates comparison of health inequality aversion across different countries and studies. This comparability is crucial for understanding how different societies value health equity and for informing policy decisions. However, an important limitation of this approach is that its findings are generally more robust and comparable when interpreted as ordered categories rather than cardinal parameters, as described in more detail in the discussion section of this paper.

In Australia, Nord et al., (1995a) sought the views of the general public to explore the extent to which it supports distributive neutrality in economic evaluations, methods also referred to as "distributionally naïve" evaluations. They concluded that distributive neutrality had little support when resulting in reduced equity, and that the Australian public exhibits a strong egalitarian tendency. It was only when comparing a feature resulting from a behavioural aspect, such as smoking, that a clear deviation from egalitarianism was observed. Studies have also shown a general willingness within the Australian public to make significant sacrifices in terms of efficiency (i.e. health maximization), in order to improve equity or social justice (Nord et al., 1995b). However, to date, the extent to which the Australian general population is willing to sacrifice efficiency to reduce health inequalities has not been quantified nor the extent to which different members of the public might see the balance between equity and efficiency differently. A particular importance relates to the attitudes towards reducing health inequalities between Indigenous and non-Indigenous individuals. As in many other countries with a colonial past, the most striking health inequalities are found between Indigenous and non-Indigenous populations. Indigenous Australians face significant inequities in life expectancy, mortality, and morbidity (Anderson et al., 2016). These differences reflect deeply rooted historical injustices and ongoing systemic challenges that disproportionately affect the health and wellbeing of Indigenous populations. Health inequality aversion parameters have not been elicited yet for any First Nations populations.

Research to understand population health inequality aversion parameters would help at several levels. First the availability of this evidence would allow researchers to incorporate equity-specific parameters into economic evaluations such as in Distributional Cost-Effectiveness Analysis (Cookson et al., 2021b). In Australia, reducing health equity is a major concern. There are different systems in place aiming at reducing these inequalities such as the Health Care Card, granting access to cheaper medicines to individuals of low socioeconomic status (Australian Government, 2023), or medicines subsidized only for Aboriginal and Torres Strait Islander (Australian Government - Department of Health and Aged Care, 2024). However, decisions are mostly made based on a deliberative process that is not informed by quantitative analysis that can shed light on the implications of different value judgements and the degree of consistency among different judgements made in different contexts. Second at the decision-making level, evidence on inequality aversion would help to understand and incorporate the distributional value that the public would allocate to the reduction of health inequality in policy and resource allocation decisions. It would help tailor health policies to societal values and address historical and systemic inequities at the core of many systems.

The aims of this study are to (a) elicit the preferences of the Australian general public with respect to health inequality, comparing inequality aversion parameters for health inequalities defined using three different equity-relevant variables: income group, indigenous status, and geographic location and (b) to analyse underlying variations in the attitudes of different sociodemographic subgroups towards these health inequalities. Inequality aversion parameters for the Atkinson and Kolm SWF are elicited for each of these 3 contexts, and we investigated whether individual respondent sociodemographic characteristics change the significance of this balance.

2. Methods

2.1. Questionnaire development

The questionnaire and a flow chart of the survey sections are reported in Appendix A. Three inequality scenarios are designed based on variables considered important in Australia (1): income group, (2) Indigenous status, and (3) geographic location. These are identified and selected based on a literature review (Australian Institute of Health Welfare, 2018; Flavel et al., 2022). The health indicator selected is life expectancy at birth. Even though life expectancy at birth is deemed as being a crude indicator, it may be more easily understood by the general public compared to other measures such as Quality Adjusted Life Expectancy (QALE) or Quality Adjusted Life Years (QALY). Life expectancies are extracted from the Australian Institute for Health and Welfare (AIHW) reports for the richest fifth and poorest fifth (in the income group scenario), Indigenous and non-Indigenous (in the Indigenous status scenario) (Australian Institute of Health Welfare, 2020), and people living in major cities and those living in rural areas (in the geographic location scenario) (Australian Institute of Health Welfare, 2019). The Indigenous group includes people of Aboriginal and Torres Strait Islander descent, and "rural" areas encompass very remote, remote, rural, outer regional, and inner regional, matching AIHW grouping.

Respondents are asked to watch a 5-minutes animated video featuring a debate among 4 characters advocating for different ethical principles. The video was developed in the UK (Cookson et al., 2018) and adapted for use in Australia by editing the script and adding subtitles to improve clarity (Eliciting health inequality aversion parameters, 2023).

Respondents are then presented with the benefit trade-off exercise. The questionnaire includes five pairwise options per scenario, adapted from Robson et al. (2017) and constructed based on questions designed by Shaw et al., (2020). Each question displays two programs (Program A

and Program B), each adding a different number of years to the life expectancy at birth of the two different groups considered. To aid respondents' cognitive processing of the task, Program A always provides more years of life to the more advantaged group (richest fifth, non-Indigenous, and people living in major cities) in each scenario, and the number of years added remains constant. Program B favours the more disadvantaged group (poorest fifth, Indigenous, and people living in rural areas). The number of years added to the more advantaged group is constant while the number of years to the less advantaged group decreases, titrated from the most-efficient-and-least-equal to the least-efficient-and-the-most-equal. Respondents are asked to choose the option they prefer among "Program A", "Program B″ and "Program A and Program B are equally good".

The five questions result in 11 combinations of answers with one indifference point to which is assigned a different view label ranging from 'non-egalitarian' to 'egalitarian'. The five questions within each scenario followed a top-down titration. However, the three different scenarios (income group, Indigenous status, and geographic location) are randomized. The survey is designed in Qualtrics.

2.2. Survey sample, recruiting, and data quality

Pureprofile, a survey company, is contracted to provide an Australian nationally representative sample of 3105 respondents by age, gender, state of residence, income level, and highest education level attained. The quotas are extracted from the Australian Bureau of Statistics (Australian Bureau of Statistics, 2019; Australian Bureau of Statistics, 2019b; Australian Bureau of Statistics, 2019c). The survey company recruits respondents and facilitates linking participants to the survey. In order to match the population statistics, data are weighted using STATA *ipfraking* command. This command applies inverse probability of treatment weighting using propensity scores and assigns individual weights to each observation. A few quality checks are pre-specified, and data are monitored according to the following criteria: patterned or 'straight-line' answers are screened out along with speedy answers. Straight-liners are defined as participants finding Program A and Program B equally good (option B) throughout the entire exercise. Participants who only selected Program A and those who only selected Program B could not be screened out as these could be logical answers either favouring health gains to the better-off or worst off. Speeders are defined as respondents taking less than 30% of the sample median time to answer all questions excluding the time needed to watch the video, calculated based on the first 200 responses received. Three minimum eligibility criteria questions, referred to as quality check question 1, 2, and 3 in Appendix B, were included in the survey to exclude respondents who are not minimally graph literate or those not sufficiently focusing on the tasks.

To control for internal consistency and discriminatory views, three sets of questions are included in the survey: three warm up questions aiming to obtain a general understanding of the respondents' thoughts on inequality (Appendix A.4), four questions based on the Scanlon Foundation survey (The Scanlon Foundation Surveys, 2019) intending to screen for discriminatory views (Appendix A.5), and a multiple-choice question following the video seeking respondents' views around the character they most agree with. Answers are combined, compared to tasks' results, and included in sensitivity analyses. The Scanlon Foundation conducts or commissions research on social cohesion, multiculturalism, and related topics in Australia. It has established a bench mark for high-quality social cohesion surveys, first conducted in 2007, and annually since 2009 (Scanlon Foundation Research Institute).

2.3. Pilot testing

To ensure the task is designed to facilitate clear understanding, three pilot phases are run with convenience samples. 15 respondents are asked in interviews to complete the questionnaire each pilot phase. Time taken to fill out the questionnaire is recorded, and a discussion followed to hear the respondents' comments about the clarity and difficulty of the task. The data was analysed to check if any problems arise from data entry and analysis. At the end of each pilot phase, small survey modifications are made to increase the exercise's clarity and presentation, and the survey is retested.

2.4. Categorization

Following the experimental design in Robson et al., (2017), we establish a similar categorization of response to elicit the health inequality parameters. The point at which the respondent becomes indifferent between programs was determined as the "switching" point and used to calculate the Atkinson and Kolm indices. This was applied to each of the 3 scenarios. Five types of individuals are characterised, labelled, and defined in Table 1. This was categorized using 11 ranks representing progressive addition of the level of health equity concerns, from Pro-Rich/Pro-non-Indigenous/Pro-Urban (rank 1) to Egalitarian (rank 11).

In Appendix C, tables 1, 2, and 3 show the categorization of each scenario, the income group, the Indigenous status, and the geographic location, respectively. The sequence of participants' responses that do not fall in any of the pre-defined categories are deemed "invalid" and are excluded from the analysis. These participants exhibit two or more indifference points i.e. indicating inconsistent inequality preferences.

2.5. Prompts for reconsideration of responses

Participants whose answers did not fall into one of the response categories shown in tables 1, 2, 3 of Appendix C are discarded from the sample. Their responses are deemed invalid due to the presence of several switching points. Aiming at reducing the number of participants discarded from the analysis, prompts were constructed within the survey asking respondents to reconsider certain questions where two or three switching points are present in their responses. When answers include multiple switching points, participants are asked to review the entire task, but only if this occurred in the last of the 3 scenarios presented to reduce the burden on participants.

2.6. Parameter elicitation

The Equally Distributed Equivalent (EDE) level of health is defined as the mean level "which if equally distributed would give the same level of social welfare as the present distribution" (Atkinson, 1970). It is based

Table 1
Definition and ranks of the different categories of responses.

Category	Definition	Rank
Pro-Rich Or Pro-non-Indigenous Or Pro-Urban	Refers to individuals who only care about the improvement of health of the better off (i.e. to the richest fifth, to non-Indigenous populations, or to those living in urban areas).	1
Health Maximisers	Individuals who are only concerned with the improvement of total health gain with no distributional concerns at all.	2
Weighted Prioritarian	The group of people who gives *some* priority to the worse-off but not an exclusive one, balancing it with other considerations. This group consists of 7 levels, each accounting for increasing magnitudes of equity concerns.	3 4 5 6 7 8 9
Maximin	Individuals who chose to improve the health of the worse-off regardless of total health.	10
Egalitarian	Individuals who are willing to level down the health of the better off to have a more equitable distribution between better off and worse off.	11

on the concept of Atkinson's EDE income. The inequality aversion parameters of interest are calculated by numerically solving the following EDE equations:

$$(1)\ \mathrm{EDE}_{\mathrm{Atkinson}} = \overline{H}\left[\sum\left(\frac{H_i}{\overline{H}}\right)^{1-\varepsilon} f(x_i)\right]^{1/(1-\varepsilon)} \tag{1}$$

$$(2)\ \mathrm{EDE}_{\mathrm{Kolm}} = \overline{H} - \left[\left(\frac{1}{\alpha}\right) log \sum e^{\alpha(\overline{H}-H_i)} f(x_i)\right] \tag{2}$$

Where ε and α are the inequality aversion parameters for the Atkinson and Kolm HRSWFs respectively, H_i is the level of health for subgroup i, $\overline{H}$ is the mean level of health for the entire population and $f(x_i)$ is the proportion of the population in subgroup i.

For each participant, the survey allows the identification of 2 points lying on the same social welfare contour. The indifference point of each respondent is either explicitly stated by the respondent when answering that both programs are equally good or calculated as the mid-point between the 2 states when the participant's preference shifts. This indifference point suggests that both states (programs in our case) provide the same welfare and consequently we can equate the EDE.

Starting with the Atkinson parameter:

$$\mathrm{EDE}_{\mathrm{ProgramA}} = \mathrm{EDE}_{\mathrm{ProgramB}}$$

$$\overline{H_A}.\left[\sum\left(\frac{H_{iA}}{\overline{H_A}}\right)^{1-\varepsilon} f(x_{iA})\right]^{1/(1-\varepsilon)} = \overline{H_B}.\left[\sum\left(\frac{H_{iB}}{\overline{H_B}}\right)^{1-\varepsilon} f(x_{iB})\right]^{1/(1-\varepsilon)} \tag{3}$$

With 2 populations of interest - 1 and 2 (e.g., richest fifth and poorest fifth, or Indigenous and non-Indigenous, or people living in major cities and people living in remote areas) – the formula yields the following development:

$$\overline{H_A}.\left[\left(\frac{H_{1A}}{\overline{H_A}}\right)^{1-\varepsilon}.f(x_{1A}) + \left(\frac{H_{2A}}{\overline{H_A}}\right)^{1-\varepsilon}.f(x_{2A})\right]^{\frac{1}{1-\varepsilon}} =$$

$$\overline{H_B}.\left[\left(\frac{H_{1B}}{\overline{H_B}}\right)^{1-\varepsilon}.f(x_{1B}) + \left(\frac{H_{2B}}{\overline{H_B}}\right)^{1-\varepsilon}.f(x_{2B})\right]^{1/(1-\varepsilon)} \tag{4}$$

We applied the same principle to elicit the Kolm parameter, solving for $\mathrm{EDE_A} = \mathrm{EDE_B}$

$$\overline{H_A} - \left[\left(\frac{1}{\alpha}\right) log \sum e^{\alpha(\overline{H_A}-H_{iA})} f(x_i)\right] = \overline{H_B} - \left[\left(\frac{1}{\alpha}\right) log \sum e^{\alpha(\overline{H_B}-H_{iB})} f(x_i)\right] \tag{5A}$$

$$\overline{H_A} - \left[\left(\frac{1}{\alpha}\right) log\left(\left(e^{\alpha(\overline{H_A}-H_{1A})} \bullet f(x_{1A}) + e^{\alpha(\overline{H_A}-H_{2A})} \bullet f(x_{2A})\right)\right)\right] = \overline{H_B} - \left[\left(\frac{1}{\alpha}\right) log\left(\left(e^{\alpha(\overline{H_B}-H_{1B})} \bullet f(x_{1B}) + e^{\alpha(\overline{H_B}-H_{2B})} \bullet f(x_{2B})\right)\right)\right] \tag{5B}$$

The values of ε and α are calculated by using the "solver" tool in Microsoft excel (Version 16.52). This tool adjusts multiple variables within specified constraints to find the best possible solution for maximizing or minimizing an objective function.

After calculating the values of ε and α, the implied weight of each parameter given marginal improvement in the health of the worse off (e.g. poorest fifth) compared to the health of the better off (e.g. richest fifth) can be calculated from the marginal rate of substitution, defined in each case as:

$$\text{Atkinson implied weight}: \frac{dH_i}{dH_j} = \left(\frac{\mathrm{Hi}}{\mathrm{Hj}}\right)^{\varepsilon} \tag{6}$$

$$\text{Kolm implied weight}: \frac{dH_i}{dH_j} = e^{-\alpha\,(H_j - H_i)} \tag{7}$$

Where Hi refers to the health of the better off and Hj to the health of the worst off. The parameters 95% confidence intervals are calculated by bootstrapping the weighted sample, ensuring it accurately represents the population. The STATA command *bsweights* by Kolenikov are used and the sample considered in this case participants who completed the initial screening and eligibility check.

2.7. Median response by sociodemographic subgroup

To study the association between respondents' sociodemographic characteristics on their attitudes towards health inequalities, a model is constructed. Socioeconomic status is proxied using income (inc) and education (educ). Demographic status included age, gender, and geographic remoteness (remoteness). An ordered probit regression is run with the inequality aversion rank as the dependent variable and the five characteristics as independent variables (Equation (8)). The health inequality aversion rank is based on the categorization mentioned in Table 1.

$$\mathrm{Rank_i} = \alpha\ \mathrm{gender_i} + \beta\ \mathrm{age_i} + \gamma\ \mathrm{educ_i} + \delta\ \mathrm{inc_i} + \theta\ \mathrm{remoteness_i} + \varepsilon_i \tag{8}$$

Gender is included as a dummy variable, while inequality aversion rank, age, household income level, highest education level attained, and geographic remoteness are included as categorical variables. Details are provided in Appendix D.

2.8. Sensitivity analyses

The base case includes all valid answers (i.e. having one indifference point) before any respondents are asked to reconsider their answers. We study the sensitivity of results to changing the exclusion and inclusion criteria applied to the responses.

A first set of sensitivity analyses relax the inclusion criteria to include some of the responses that were initially classified as invalid due to having 2 or more indifference points, but switched to a valid response once answers were reconsidered: a first sensitivity analysis (1.a) includes responses characterized as rational when one question is reconsidered. A second sensitivity analysis (1.b) includes responses that became rational when one or two questions are reconsidered and a third sensitivity analysis (1.c), combines (1.a) and (1.b) and adds participants who submitted valid answers after reconsidering the entire third task (i.e., all 5 questions).

A second set of sensitivity analyses expand exclusion criteria for internal consistency of responses and screening for extreme discriminatory views. Participants are excluded when task results and warm up questions views do not match indicating inconsistency in their approach to the survey (2.a). A second sensitivity analysis (2.b) excludes the views of participants that may be considered unethical or unacceptable based on the discriminatory questions screening for 'racism' to reflect the undesirability for health policy decisions to be based on discriminatory views.

A third set of sensitivity analysis included answers having 2 or 3 (3.a) consecutive indifferent points. In this case, consecutive indifferent points refer to situations where the respondents switch between 2 programs multiple times throughout the task or indicates that the two programs are rated by respondents as equally good on several consecutive questions. These responses are deemed imprecise rather than invalid. In the first case, the first indifference point was assumed taken into account, while in the second case, the "equally good" in the middle was assumed to be the respondent's indifference point. Further details on these sensitivity analyses are provided in Appendix E.

3. Results

3.1. Sample characteristics

The online survey was completed by 3105 participants in May 2022. Recruitment followed set quotas for gender, age, state of residence, education, and household income level with the aim of achieving a sample representative of the Australian population. Participants whose answers do not match the established categorization of responses are excluded from the analysis as they exhibit several points of indifference. This results in the inclusion of 2422 (78%) participants in the estimation of aversion to inequality in the distribution of health gains across different income groups, 2383 (77%) participants when health gains are distributed between Indigenous and non-Indigenous groups, and 2419 (78%) participants when health gains are distributed across different geographic locations – remote and urban areas. Table 2 shows the respondents characteristics in each sample compared with those of the Australian population. Weights are generated for each individual within each sample to ensure sample representativeness.

3.2. Data quality and sensitivity analysis

5540 participants attempt to complete the survey: 3105 complete it and 2435 are screened out at different points for not meeting eligibility criteria or not answering correctly the quality check questions (Fig. 1). The sample that submitted the survey is more educated, younger, and from higher income groups compared to the sample who did not reach the end of the survey (Appendix F). Of the 3105 who completed the survey, 683 are discarded due to invalid responses in the scenario comparing health gains between the richest and poorest quintiles and 2422 are included in the final analysis. In the scenario comparing health gains between Indigenous and non-Indigenous, 721 responses are invalid and resulting in 2384 responses included. In the scenario comparing health gains between people living in major cities and those in rural areas, 686 responses are invalid, leaving 2419 for the analysis. We compared the characteristics of respondents who were excluded from the analysis to those who were included and did not find any substantial differences.

In all 6 sensitivity analyses conducted, the median respondent's rank does not change and thus the inequality aversion parameters are robust to the inclusion/exclusion criteria tested. Appendix E shows the changes in sample size in each analysis and the rank.

3.3. Parameters computation

The parameters and their implied weights are calculated for each of the 3 scenarios (Tables 3–5).

When presented with the scenario comparing health gains between the richest and poorest fifth, 88% (95% CI: 82%–92%) of the public exhibit some aversion to inequality and preferences for implementing higher weights at the lower end of the distribution. 42% (95% CI: 34%–51%) of the respondents are classified as weighted prioritarian and 42% (95% CI: 34%–51%) as egalitarian. At the other end of the spectrum, 11% (95% CI: 7%–17%) are pro-rich and only 2% (95% CI: 1%–2%) are strict health maximizers and 3% (95% CI: 2%–5%) are maximin (Fig. 2).

The median respondent falls into the highest level of weighted prioritarian with an Atkinson index of 27.16, a Kolm index of 0.318. The corresponding implied weight of 5.19 suggests that at initial levels of life expectancy at birth (85 years for the richest fifth and 80 years for the poorest fifth), the public is willing to weight incremental health gains to the poorest fifth of people in society five times more than incremental health gains to the richest fifth.

Respondents similarly demonstrated aversion to health inequality when faced with the Indigenous status scenario: 85% of the public support trading off maximization of health gains to reduce inequalities in health between Indigenous and non-Indigenous populations. 40% (95% CI: 31%–49%) express egalitarian views and 41% (95% CI: 33%–51%) weighted prioritarian weighting gains in health against reduction in health inequalities, and 4% (95% CI: 2%–6%) are maximin. 14% (95% CI: 9%–20%) express pro-non-Indigenous views and are at the other end of the spectrum along with the 2% (95% CI: 1%–2%) health maximizers (Fig. 2). The median respondent is also a weighted prioritarian category 7 and has an Atkinson index of 17.73 and a Kolm index of 0.216. The indices translate into an implied weight of 6.15, suggesting that the public would weight incremental health gains to Indigenous groups six times as highly as to non-Indigenous, given initial level of life expectancy at birth (non-Indigenous individuals: 82 years, Indigenous individuals: 74 years).

Table 2
Summary statistics of respondents.

		Income group scenario sample n = 2422	Indigenous scenario sample n = 2384	Geographic location scenario sample n = 2419	[a]Australian population
Sex	Male	36.0%	35.1%	35.1%	49.6%
	Female	64.0%	64.9%	64.9%	50.4%
Age	18–34	34.6%	34.9	34.4%	31.3%
	35–49	35.9%	36.9%	36.4%	25.6%
	50–64	19.7%	18.8%	19.0%	22.6%
	65–70	7.6%	7.6%	8.0%	15.3%
	80 or older	2.4%	1.9%	2.2%	5.2%
State	Australian Capital Territory	1.2%	1.3%	1.2%	1.7%
	New South Wales	32.8%	31.5%	31.5%	31.9%
	Northern Territory	0.04%	0.63%	0.66%	1.0%
	Queensland	25.3%	25.3%	25.5%	20.0%
	South Australia	3.6%	3.9%	3.9%	6.9%
	Tasmania	1.5%	1.3%	1.5%	2.1%
	Victoria	29.6%	29.7%	29.4%	26.0%
	Western Australia	6.2%	6.4%	6.3%	10.3%
Education	High school or less	19.4%	19.0%	20.0%	26.2%
	Certificate	19.8%	20.1%	19.4%	10.2%
	Advanced diploma	14.7%	14.4%	14.5%	21.0%
	Bachelor or higher	46.1%	46.5%	46.1%	42.6%
Income	Less than $51,999	24.0%	22.2%	23.6%	29.2%
	$52,000-$98,799	27.1%	28.6%	28.4%	25.7%
	$98,800-$155,999	30.3%	30.8%	29.6%	21.8%
	More than $156,000	18.7%	18.5%	18.4%	23.3%

[a] Data of the Australian population extract from the Australian Bureau of statistics,2019[25,26,27].

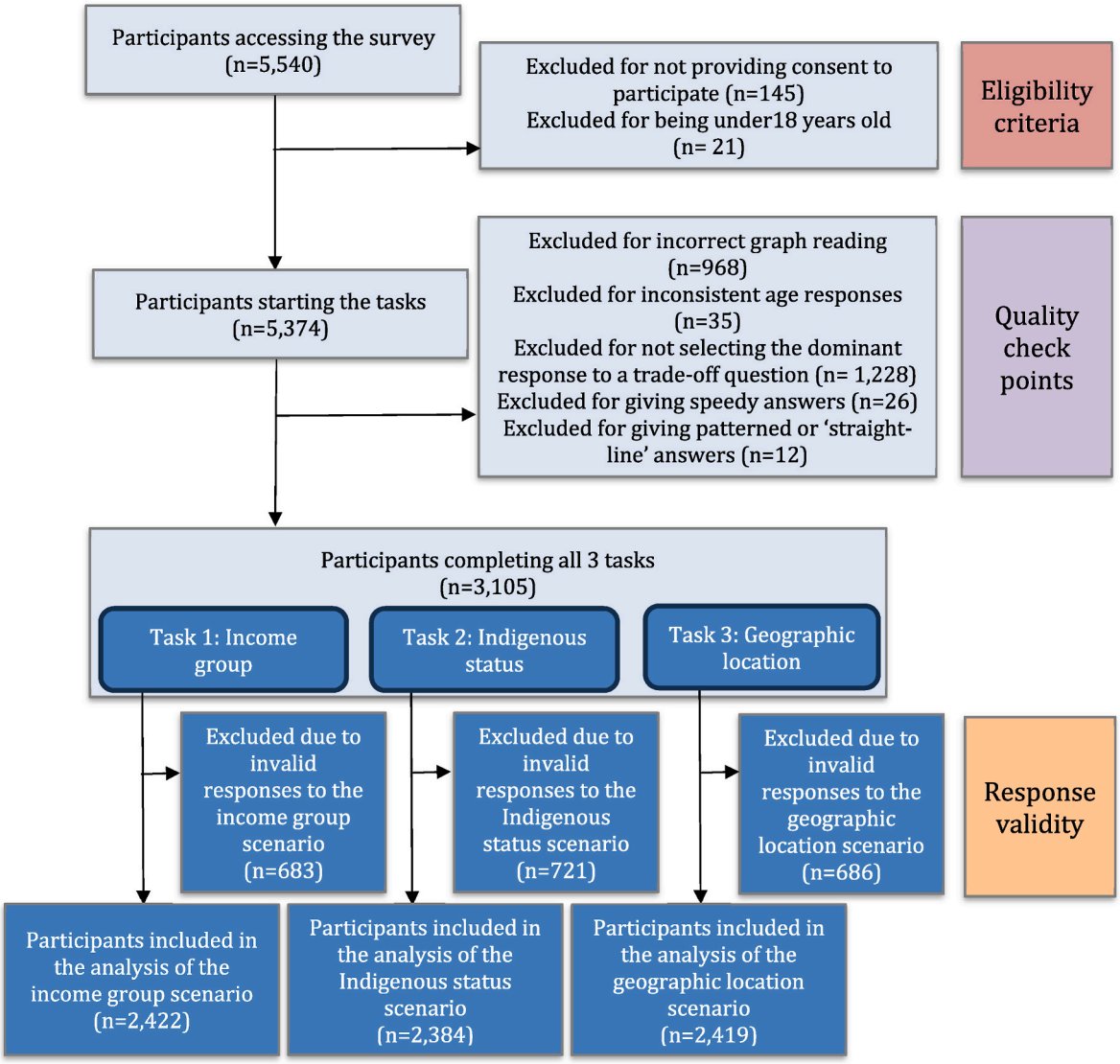

Fig. 1. Flow diagram of the survey respondents from initiation to final inclusion in the analysis.

Comparing health inequalities between people living in major cities to those living in rural areas, the majority of the public, 88% (95% CI: 66%–80%) similarly favours decreasing the health inequalities between these 2 groups: 44% (95% CI: 29%–46%) revealed egalitarian views, 2% (95% CI: 1%–4%) maximin, and 43% (95% CI: 27%–43%) showed weighted prioritatian views. 9% (95% CI: 4%–14%) of the respondents are pro-urban, and 1% (95% CI: 1%–2%) show health maximizing views (Fig. 1). The median respondent in this scenario is also weighted prioritarian category 7 with an Atkinson index of 31.7 and a Kolm index of 0.378. This would imply a weight of 4.79, suggesting that at initial levels of life expectancy at birth (83 years for those living in major cities, and 79 years for those living in rural areas), incremental health gains to those living in rural areas should be weighted between four and five times as highly as the gains to those living in major cities (Table 6). In the three scenarios, the Atkinson and Kolm implied weights are very similar.

3.4. Median responses by sociodemographic subgroup

The median respondents in the three scenarios considered (income group, indigenous status, and geographic location) differ by sociodemographic subgroup. Detailed results are shown in Appendix G.

The estimates in Table 7 show the results of the regression analysis: the coefficients for females are positive, indicating that, keeping all other variables constant, females tend to be more egalitarian than males across the 3 scenarios. Age does not seem to have a statistically significant impact. In the income group scenario alone, individuals with higher household income seem to be less egalitarian when compared to individuals with lower household income. In the geographic location scenario alone, individuals with an advanced diploma are less egalitarian compared to those with a high school degree. Also, compared to individuals living in major cities, those living in rural areas are less egalitarian when considering Indigenous status and geographic location.

4. Discussion

The findings provide key quantitative insights into public's preferences regarding aversion to health inequality, with 40% and 44% of the respondents exhibiting extreme inequality aversion across the 3 dimensions. They attribute positive weights to Indigenous individuals, people from lower income groups, and persons living in rural areas in increasing magnitudes.

The first strength of the study is its pioneering effort to consider Indigenous status as an equity-relevant variable in the context of health inequality aversion. An essential step towards achieving health equity in today's societies is recognizing the health inequalities between

Table 3
Health inequality aversion parameters – Atkinson and Kolm indices- and their implied weights for the income group scenario.

Rank	Category	Atkinson's index	Atkinson's implied weight	Kolm's index	Kolm's implied weight
1	Pro-rich	−2.15	0.88	−0.02	0.88
2	Health maximizer	0.00	1.00	0.00	1.00
3	Weighted prioritarian 1	2.20	1.14	0.025	1.14
4	Weighted prioritarian 2	4.52	1.31	0.05	1.30
5	Weighted prioritarian 3	7.08	1.60	0.08	1.51
6	Weighted prioritarian 4	10.03	1.54	0.12	1.79
7	Weighted prioritarian 5	13.66	2.29	0.16	2.22
8	Weighted prioritarian 6	18.65	3.10	0.22	2.97
9	Weighted prioritarian 7	27.16	5.19	0.32	4.90
10	Maximin	∞	∞	∞	∞
11	Egalitarian	NA	NA	NA	NA

*Life expectancy of the richest fifth: 85 Life expectancy of the poorest fifth: 80.
**The Atkinson index of the egalitarian category is undefined. With the violation of monotonicity, the conventional HRSWFs cannot accommodate such preferences (Abasolo and Tsuchiya, 2004).

Table 4
Health inequality aversion parameters – Atkinson and Kolm indices - and their implied weights for the Indigenous status scenario.

Rank	Category	Atkinson's index	Atkinson's implied weight	Kolm's index	Kolm's implied weight
1	Pro-Non-Indigenous	−1.26	0.89	−0.015	0.89
2	Health maximizer	0.00	1.00	0.00	1.00
3	Weighted prioritarian 1	1.34	1.15	0.016	1.14
4	Weighted prioritarian 2	2.80	1.33	0.03	1.31
5	Weighted prioritarian 3	4.44	1.58	0.05	1.54
6	Weighted prioritarian 4	6.37	1.92	0.08	1.86
7	Weighted prioritarian 5	8.78	2.46	0.11	2.35
8	Weighted prioritarian 6	12.10	3.46	0.15	3.25
9	Weighted prioritarian 7	17.73	6.15	0.22	5.65
10	Maximin	∞	∞	∞	∞
11	Egalitarian	NA	NA	NA	NA

*Life expectancy of non-Indigenous: 82 - Life expectancy of Indigenous: 74.
****The Atkinson index of the egalitarian category is undefined. With the violation of monotonicity, the conventional HRSWFs cannot accommodate such preferences (Abasolo and Tsuchiya, 2004).

Indigenous and non-Indigenous populations. Indigenous populations account for 6.2% of the global population and are nearly three times more likely to live in poverty compared to their non-Indigenous counterparts. They live in more than 90 countries spanning from the Asia Pacific region, all through to Europe and to the Americas (United Nations). The public's aversion towards Indigenous health inequity in Australia shows evidence of the willingness of the public to address these issues. Second, the study touches on universal equity dimensions. It exhibits a richness of data being the first study to have a large sample size, resulting in more robust estimates. Third, this study actively

Table 5
Health inequality aversion parameters – Atkinson and Kolm indices - and their implied weights for the geographic location scenario.

Rank	Category	Atkinson's index	Atkinson's implied weight	Kolm's index	Kolm's implied weight
1	Pro-Urban	−2.68	0.88	−0.03	0.78
2	Health maximizer	0.00	1.00	0.00	1.00
3	Weighted prioritarian 1	2.67	1.14	0.03	1.29
4	Weighted prioritarian 2	5.44	1.31	0.06	1.33
5	Weighted prioritarian 3	8.44	1.51	0.10	1.61
6	Weighted prioritarian 4	11.87	1.80	0.14	2.02
7	Weighted prioritarian 5	16.08	2.21	0.19	2.72
8	Weighted prioritarian 6	21.85	2.94	0.26	4.17
9	Weighted prioritarian 7	31.70	4.79	0.38	8.77
10	Maximin	∞	∞	∞	∞
11	Egalitarian	NA	NA	NA	NA

*Life expectancy of individuals in major cities: 83 - Life expectancy of individuals in rural areas: 79.
**The Atkinson index of the egalitarian category is undefined. With the violation of monotonicity, the conventional HRSWFs cannot accommodate such preferences (Abasolo and Tsuchiya, 2004).

addresses challenges encountered in prior research efforts and thus offers substantial improvements upon the existing survey designs. Notably, we meticulously tackled issues related to the prevalence of invalid responses and ensured the survey's adaptability to the context by selecting relevant equity dimensions, health metrics, and language used. After screening participants with quality check questions, we were able to reduce the proportion of completed responses considered to be invalid and consequently discarded, from 53% in a prior study also conducted via online survey (Robson et al., 2017), to between 22 and 23% in the current study. In addition to eliciting health inequality aversion parameters across different subgroups of the society, we looked at the distribution of responses by category.

The study has several limitations. First is the potential methods vulnerability to respondents' insensitivity to the level of baseline health and the size of the health benefit (Baron and Greene, 1996). Respondents may find it hard to weigh up quantitative magnitudes accurately, especially when those magnitudes involve cognitively demanding trade-offs. The large difference in Atkinson parameters estimated in this study among the three equity-relevant dimensions, and the median response falling in the highest level of weighted prioritarian may be driven by differences in baseline health rather than differences in the proportion of respondents who are inequality averse. It is not known how far various other methods for eliciting health inequality aversion parameters are vulnerable to this and other framing effects, since they have not yet been tested. It is also unknown to what extent the video in our study assisted participants with the task and it is acknowledged that it was a simplification of the ethical principles that they were then asked about in the tasks. Second, the exercise's design is complex, the task is cognitively demanding, and graph and computer literacy are required. This might render the exercise difficult for the public to understand and may limit its accessibility to certain population groups. Consequently, it could be that only people who feel strongly for the topic and those who own an electronic device will complete the survey which could potentially bias the results. It is not entirely clear what direction the bias may operate although those who are lower income or more remote in our analyses were shown to have a higher level of health inequality aversion. Several measures were taken to ascertain the participation of all sociodemographic categories and to avoid

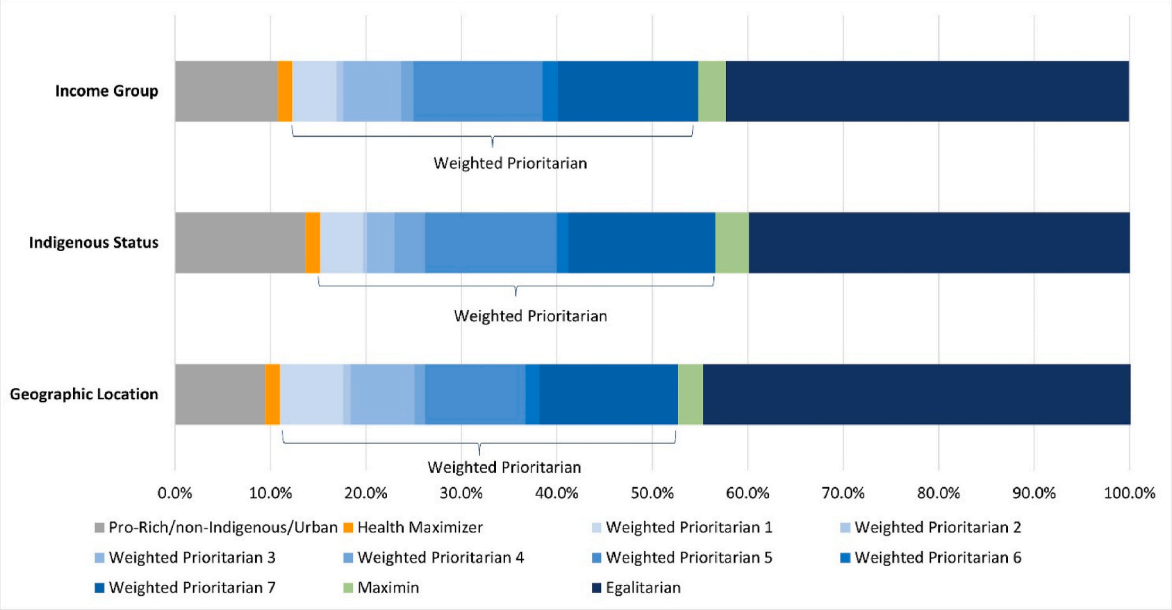

Fig. 2. Cumulative distribution of the level of health inequality aversion of respondents across groups of different income group, Indigenous status, and geographic location.

Table 6
Health inequality indices and implied weights of median respondents for each of the three scenarios considered: income group, Indigenous status, and geographic location.

Scenario	Median Atkinson (95% CI)	Implied weight (95% CI)	Median Kolm (95% CI)	Implied weight (95% CI)
Income group	27.16 (27.16–27.16)	5.19 (5.19–5.19)	0.318 (0.318–0.318)	4.90 (4.90–4.90)
Indigenous status	17.73 (17.73–17.73)	6.15 (6.15–6.15)	0.216 (0.216–0.216)	5.65 (5.65–5.65)
Geographic location	31.70 (31.70–31.70)	4.79 (4.79–4.79)	0.378 (0.378–0.378)	8.77 (8.77–8.77)

Table 7
Ordered probit estimation by scenario.

Variable		Income group scenario	Indigenous status scenario	Geographic location status scenario
Sex	Male (reference)			
	Female	0.323[a]	0.427[a]	0.394[a]
Age	18-34 (reference)			
	35–49	−0.192	−0.254	−0.269
	50–64	0.202	0.264	0.191
	65–79	−0.392	0.327	−0.405
	80 or older	−0.158	0.185	−0.149
Income[d]	Less than $52,000 (reference)			
	$52,000-$98,700	−0.157	−0.056	0.00509
	$98,800-$155,900	−0.521[a]	−0.320	−0.361
	$156,00 or more	−0.516[c]	−0.327	−0.295
Education	High school degree or lower (reference)			
	Certificate	−0.657	−0.486	−0.692
	Advanced diploma	−0.289	−0.349	−0.545[c]
	Bachelor or higher	−0.265	−0.181	−0.389
Remoteness	Major cities (reference)			
	Regional and remote	−0.158	−0.394[b]	−0.244[c]

[a] Denotes significance at 1%.
[b] Denotes significance at 5%.
[c] Denotes significance at 10%.
[d] Income is in 2019 Australian dollars.

excluding unwillingly any segments of the society, such as those with lower levels of education or income. Quotas (age, gender, state of residence, income level, and education level) were set and advertisement of the survey by Pureprofile targeted the participant categories that were under-represented. The panel has a very diverse composition, with 44.6% of panel enrolees covering more than 24 different ethnicities. Subtitles were also added to the video to ensure easier understanding and access. Third, the construct and methodological foundations of the exercise required participants with several indifference points to be discarded from the analysis. This was addressed by adding extra quality checks, screening questions, and prompts urging the respondents to reconsider their answers. These measures have considerably reduced the number of discarded responses compared to previous studies (Robson et al., 2017) and offer useful guidance for future studies in this area. While different sociodemographic groups may have very different opinions about health inequality aversion, we studied the characteristics of respondents whose answers were discarded and found no major differences between their characteristics and those of respondents whose included answers were included. Fourth, the parameters obtained reflect the strength of the inequality aversion at the current level of inequality. Thus, the parameters obtained are context specific, time specific, and preference specific. Since the parameters are estimated based on the outcome distributions at which respondents' express indifference, the resulting weights could vary depending on the current distribution of baseline inequality in the specific scenarios presented, and the magnitude of the weights obtained depends on the magnitude of baseline inequality in the specific scenarios presented. The resulting parameter estimates for aversion to health inequality among social groups tend to be higher than parameter estimates for aversion to income inequality among individuals – two very different scales are used (i.e. the life expectancy scale vs income dollar scale).

Previous studies have shown that a large majority of the Australian general public wants their views to be part of the process of health care decision-making (Wiseman et al., 2003). Health researchers are thus seeking to understand and include what the Australian public values in health-related decisions, such as preferences about aspects of public hospital services (Jan et al., 2000), healthcare reforms (Louviere and Flynn, 2010), or on the value placed on health improvement and severity of illnesses (Richardson et al., 2011).

In the three studied scenarios, our results confirm Nord's conclusion of Australia's egalitarian tendency (Nord et al., 1995b) and goes a step further to quantify it. A strong aversion to inequality revealed the willingness of the public to allocate additional resources to disadvantaged groups, even when it results in reducing resources and consequently health gains to other subgroups. In other words, it indicates preferences to allocate a higher priority to the worst off in terms of income (poorest fifth), to Indigenous individuals, and to those living in rural areas, but not an exclusive priority. The high proportion of pure egalitarian responses observed suggests that many respondents may not hold complete and consistent preferences that align with the SWF framework of rational social choice. A lack of complete and consistent preferences is consistent with a substantial body of knowledge from the cognitive psychology and behavioural economics literature around systematic biases in judgement and decision making: even experienced professionals are vulnerable to cognitive overload, bounded rationality, and information processing limitations that can lead to inconsistencies in responses during preference elicitation exercises (Abdellaoui et al., 2011). These inconsistencies may highlight the need for more deliberative processes, allowing respondents to reflect on trade-offs, rather than necessarily pointing to a flaw in the SWF framework and a need to develop a new framework for rational or non-rational social choice.

It also aligns with Lal's study (Lal et al., 2018) eliciting health inequality aversion in Australia from a group of health professionals, resulting in a weight of 14.1–81.4 to the marginal health gains to the poorest fifth compared to that of the richest.

The level of egalitarianism of the population is captured through the median respondent of a survey which has been used in the United Kingdom (UK) (Robson et al., 2017; Ali et al., 2017; Dolan and Tsuchiya, 2011), Spain (Abásolo and Tsuchiya, 2013), and Portugal (Pinho and Botelho, 2018; Quintal, 2009). In the UK, the public's Atkinson health inequality aversion parameters range between 10.87 and 28.9 when considering differences in health between income groups with an implied weight of six in the latest study (McNamara et al., 2020). Abásolo and Tsuchiya, (2013) examine health inequality aversion to socioeconomic groups in Spain and obtain an Atkinson inequality aversion parameter of 28.9, remarkably similar to the parameter obtained in Australia. While in Portugal, the health inequality aversion was studied for 2 distinct groups: the first studied the differences between socioeconomic groups (Pinho and Botelho, 2018) reporting an Atkinson inequality aversion parameter ranging between 2.24 and 4.85 and the second between different geographic locations (Quintal, 2009) reporting a willingness to trade-off total gains in health in order to achieve higher geographic equity. The distribution of responses across ordered categories (e.g. pro-rich, weighted prioritarian, and strict egalitarian) varies substantially among countries and dimensions of inequality. These variations provide valuable comparative insights about the prevalence of inequality aversion and the proportion of respondents with moderate versus strong degrees of inequality aversion. Watching the video before starting the survey in a UK based study (Cookson et al., 2018) has shown that it results in a reduction in the proportion of respondents giving exclusive priority to reducing health inequality with the median response still implying high levels of health inequality aversion. A discrete choice experiments (DCE) and best-worst scaling (BWS) survey also showed preferences prioritizing health technologies that benefits Indigenous Australians and those in rural areas (Whitty et al., 2014). The strength of aversion differed by respondents' socio-demographic characteristics. While other studies in the literature did not find any significant difference between male and female views (Robson et al., 2017; Abásolo and Tsuchiya, 2008), in this survey female respondents exhibited more egalitarian tendency than males across all 3 scenarios. Basic gender differences have emerged in economic behaviour showing women to be more socially oriented than men [39], more sympathetic towards equity (Lindholm et al., 1997) and willing to contribute to an egalitarian health service (Lee and Park, 2015). Age has shown heterogenous results: Abásolo and Tsuchiya, (2008) concluded that younger and older individuals are likely to target the egalitarian policy, Robson et al., (2017) albeit with a smaller sample size did not observe any significant difference. Quintal studied the aversion to health inequality between regions and did not find any preference variation (Quintal, 2009).

While there is a substantial body of evidence suggesting that individuals value both efficiency and equity in health, there is limited knowledge regarding the valuation of the equity-efficiency trade-off. Different methods strive to quantify the magnitude of the public's preferences on these values by deriving weights such as equity weights (Norman et al., 2013), preference weights surrounding health-system attributes (Scuffham et al., 2010), or eliciting parameters (Robson et al., 2017). By understanding the degree to which individuals value equity and are averse to health inequalities, interventions can be tailored to align with public preferences and maximize the impact on reducing health inequalities. Eliciting health inequality aversion parameters is also essential for addressing the ethical dimensions of health and healthcare distribution and for public engagement. It ensures that decisions related to resource allocation and policy intervention are aligned with societal values and ethical principles. It allows the inclusion of the public perspective in the policy formulation process, fostering transparency and accountability. DCEA is one of the methods where these parameters can be used to examine the consequences of different social value judgements and compare different policy options balancing the trade-offs between enhancing overall health and reducing health inequalities.

This study is the first to elicit specific health inequality aversion parameters across three equity-relevant dimensions reflecting the views of the general public in Australia. These parameters are important to inform decision makers, including the PBAC, on the value the public places on decreasing inequality in health and confirms their willingness to prioritize equity in healthcare. These parameters are context specific and depend on the current level of inequality that has been posed in our survey and the survey might need to be conducted again, in the longer-term as baseline inequalities change. Further research can explore the different approaches to conducting the survey and assess the value of including a deliberative process. Additionally, it can also investigate the perspectives of various stakeholders. Indigenous communities, as key stakeholders, should have their views incorporated to provide a more comprehensive understanding of health inequities and inequality aversion.

Intersectionality of the equity dimension and how to account for the health inequality aversion when dealing with a group of individuals belonging to several equity dimensions (i.e. Indigenous and living in rural areas) are areas that can be further studied. Some research has looked at solving this concern by eliciting a "pure" or univariate inequality aversion parameter, allowing for the assessment of aversion to health inequality solely based on health outcomes. This avoids the potential challenges that can arise from attaching inequality aversion to socially advantaged or disadvantaged group, but challenges remain regarding whether and how aversion to health inequality depends on its causes (Robson et al., 2024). The incorporation of these values in numerical terms in evaluations such as DCEAs is of policy relevance and is also an area needing further assessment.

5. Conclusion

This is the first attempt to examine societal aversion to health

inequality between Indigenous and non-Indigenous groups, and to do so in a way that allow national and international comparisons with health inequality aversion preferences across income groups and geographic location groups. It also generates evidence that help inform healthcare decision-making in Australia, by eliciting the parameters and deriving the weights from a sample of the Australian population. Our findings also shed light on heterogeneity and nuance among the values and priorities of Australian society. The results provide a valuable foundation for crafting policies that address health inequalities between first nation groups and promote fair and effective resource allocation.

CRediT authorship contribution statement

Marie-Anne Boujaoude: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Kim Dalziel:** Writing – review & editing, Supervision, Investigation, Conceptualization. **Richard Cookson:** Writing – review & editing, Validation. **Nancy Devlin:** Writing – review & editing, Validation, Supervision, Conceptualization. **Natalie Carvalho:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of interest statement

The authors have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2024.117495.

Data availability

The data that has been used is available. If needed by the reviewers, we will need clear that with ethics first.

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