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Using linked Census ancestry data to examine all-cause mortality by ethnicity in Australia

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Abstract

Introduction

Ethnicity in Australia's non-Indigenous population is not collected routinely in health data but the proxy of ancestry is collected in the Census.

Objectives

We aimed to develop an approach to using ancestry data to examine health inequalities by ethnicity in Australia's non-Indigenous population. We then applied this to the example of all-cause mortality.

Methods

We established an expert and community panel to inform our approach to categorising ancestry data. This included shifting those identifying as 'Australian' or 'New Zealander' from the Oceanian to the European continental category; prioritising ethnic minority identities over national identities in those with two ancestries; and examining outcomes using the smallest ethnicity categories possible. We examined how results compared to existing approaches based on country of birth or ancestry (without our modifications) in the detection of mortality inequalities using 2016 Australian Census data linked to death registrations for 2016-2021 in 20.3 million people.

Results

We found important differences in mortality inequalities observed in Māori and Pasifika populations in Australia based on the method used. Ancestry data was able to demonstrate significantly higher mortality that was not observed when using country of birth in Māori females (747 vs 507 per 100,000 person-years), Melanesian and Papuan males (1684 vs 617 per 100,000 person-years) and Polynesian males and females (928 vs 724 in males and 693 vs 569 per 100,000 person-years in females). The size of the inequalities observed was larger using our expert and community informed approach compared to existing approaches (e.g. Polynesian males 928 vs 853 per 100,000 person-years).

Conclusions

We demonstrated an approach to using ancestry data from the Australian Census that improved identification of mortality inequalities in Māori and Pasifika ethnic groups. Inequalities were either hidden or underestimated when country of birth or the standard approach to ancestry data was used.

keywords

ethnicity; census; data linkage; mortality; inequalities

Highlights

- We engaged with an expert and community panel to inform our approach to using Census ancestry data to categorise the non-Indigenous Australian population by ethnicity
- Country of birth does not detect inequalities in all-cause mortality experienced by Māori and Pasifika ethnic groups
- The mortality inequalities observed using ancestry data are large and of public health importance, emphasising the need to move beyond country of birth in the examination of health inequalities in Australia's increasingly diverse population

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Introduction

Ethnicity is a multidimensional concept that incorporates identification with a particular group or groups based on shared culture and traditions, religion, language, and ancestral origins [1, 2]. It is challenging and complex to define, but accepted as a fluid concept that is self-perceived, driven by societal group relations [3], and varying by time [4, 5], place and context [6]. Growing ethnic diversity in many countries and evidence of health inequalities in some ethnic groups has led to increasing interest in its measurement [7–10].

Australia is a country with substantial and growing ethnic diversity [11]. There have been two predominant approaches to describing health inequalities by ethnicity in Australia. The first is a large body of work on the health of Aboriginal and Torres Strait Islander Peoples [12] – the original inhabitants of the land now known as Australia. The second body of work has concerned Australia's non-Indigenous population and has overwhelmingly focused on country of birth as the sole measure of diversity [13, 14]. A key contributing factor to this focus is the lack of ethnicity data on Australia's non-Indigenous population in administrative health data [14, 15]. Consequently, those who have been born in Australia but continue to identify strongly with a particular cultural group are excluded from consideration of health inequalities. This is a large and growing population in Australia. For example, of those reporting Lebanese ancestry in the 2021 Census, only 27% were born in Lebanon and 57% speak Arabic at home [11]. Pacific Peoples or Pasifika are also largely undercounted by country of birth or language spoken as 66% are either born in Australia or New Zealand and 59% speak English at home [11]. Country of birth also fails to identify migrants whose ethnic diversity is not captured by their country of origin, for example, the New Zealand-born Māori population [16].

The Australian Census, does, however, collect data on many cultural and language diversity measures, including Indigenous status, country of birth of person and of parents, language spoken at home, English proficiency, ancestry and religion [17, 18]. The Indigenous status question is the recommended way of identifying Aboriginal and Torres Strait Islander Australians [17] whereas the proxy of ancestry is used to identify the ethnicity of the non-Indigenous population [18]. The versions of these questions asked in the 2016 Census are shown in Box 1. The ancestry question was introduced in the 1986 Census following testing and review by an expert panel about how to measure the ethnicity of the Australian population [19]. The decision to use a question about ancestry to measure ethnicity was prompted by the difficulty of some population groups in answering an ethnicity question, with resulting differential high non-response rates [19]. Difficulties in responding were most common in the older Australian-born population. Qualitative interviews found that many of these individuals associated the word 'ethnic' or 'ethnicity' with being from an ethnic minority or migrant background and that therefore it did not apply to them [19]. Response rates were increased by providing an 'Australian' response option or a 'no ethnicity' response option [19].

Between the 1986 and 2001 Censuses, research on the ancestry question found inconsistencies in how it was interpreted and responded to [5, 20–23]. Despite the belief

Box 1: Indigenous status question and ancestry question as presented in the 2016 Census

Indigenous Status Question:

Is this person of Aboriginal or Torres Strait Islander Origin?

- For persons of both Aboriginal and Torres Strait Islander origin, mark both 'Yes' boxes
- ☐ No
- ☐ Yes, Aboriginal
- ☐ Yes, Torres Strait Islander

Ancestry Question:

What is the person's ancestry?

- Provide up to two ancestries only.
- Examples of 'Other': GREEK, VIETNAMESE, HMONG, KURDISH, MAORI, LEBANESE, AUSTRALIAN SOUTH SEA ISLANDER.
- ☐ English
- ☐ Irish
- ☐ Scottish
- ☐ Italian
- ☐ German
- ☐ Chinese
- ☐ Australian
- ☐ Other ancestry 1 (please specify) _____
- ☐ Other ancestry 2 (please specify) _____

Note: These questions were not sequential in the 2016 Census. The Indigenous Status question was question 7 and the Ancestry question was question 18.

that the 'historically-based' ancestry approach would lead to more stable response patterns, longitudinal research has found that some respondents still change their ancestry responses over time. Responses are influenced by: question wording; response options provided; current socio-political context and feelings of safety in reporting a particular ethnic or ancestral origin [5, 23]. For example, there was a decline in the response of 'English' and a jump in the response of 'Australian' between 1986 and 2001 that could not be explained by demographic trends, when the word 'identify' was used in the question and 'Australian' was provided as an example response on the Census form [23]. There has also been substantial change to the reporting of Aboriginal and Torres Strait Islander origin over time, resulting in an increase in size of this population that cannot be explained by demographic trends alone [24].

Despite the collection of ancestry data in the Census since 1986, limited use has been made of it by government organisations or researchers. Potential contributors to this include limited availability of ancestry information in data collections outside of the Census; no identifiable reference population for comparison; the ambiguous meaning of the 'Australian' ancestry response for non-Indigenous Australians; complexities in managing the reporting of multiple ancestries; and how to manage over 300 ethnicity categories without simply aggregating to only a few continental categories. The aim of this work was to review the literature and engage a panel of experts and a community panel to develop an informed approach to using ancestry data to identify health inequalities. This is timely given the recent development of linked data resources in Australia such as the Person-Level Integrated Data Asset (PLIDA) that links the Australian Census to health data [25]. The present work is focused on using the ancestry variable to categorise Australia's non-Indigenous population into ethnic groups. A subsequent discussion paper led by Aboriginal and Torres Strait Islander researchers will report on appropriate considerations for identifying Aboriginal and Torres Strait Islander peoples.

This paper is structured as follows: First, we provide a general overview of the relevant literature and the key themes. Then, in the methods section, we describe our multi-stage iterative process involving expert and community panels to develop a set of recommendations on how to operationalise the identified themes and issues, apply this to categorising the population by ethnicity, and examine ethnic inequalities in all-cause mortality. In the results section, we report this demonstration example of using these recommendations.

National identity naming as an ethnic group – the ‘Australian’ ancestry response

Members of the ethnic majority population can struggle to answer questions about their ethnic identity and may be more likely to claim the national identity as their ethnicity [3, 26]. In England and Wales, pre-specified categories mean that people are unable to identify as solely British but rather can identify as White British or Asian British for example [27]. In New Zealand, individuals descended from early European settlers have the option of identifying as New Zealander European [28]. However, this category is not without controversy, with dissatisfaction expressed by some non-European ethnic groups asking why a ‘New Zealander’ option does not exist for their ethnic group. Furthermore, some New Zealanders of European origin refuse to select New Zealander European and instead write in ‘New Zealander’ [29]. In contrast, in the Canadian and Australian Censuses respectively, it is possible to respond as being of Canadian ethnicity [30] or Australian ancestry [31].

Research conducted during the development of the Census ancestry question in the 1980s found that older people who were Australian-born were more likely to not respond to the ancestry or ethnicity question unless an option of ‘Australian’ was provided [19]. This means that the majority reporting ‘Australian’ ancestry alone are likely of Anglo-Celtic background given the predominantly British historical migration patterns to Australia [20]. This reporting pattern is further supported by the decrease in reporting of English ancestry when Australian ancestry reporting increased in the 2001 census, when the latter response option was first listed on the form [22, 23]. However, the response of Australian ancestry is also used by Aboriginal and Torres Strait Islander Peoples, although with decreasing frequency following changes to response options in the 2021 Census [23, 32]. Additionally, individuals belonging to non-Anglo-Celtic ethnic groups may choose to report both a minority ethnic identity and their Australian identity. For example, by listing both Chinese and Australian ancestry responses. A small proportion of newly arrived migrants may also choose to identify as Australian, as an indication of their aspiration to belong in their new country. However, the proportion of new migrants responding in this way is small [11, 23]. Migrant parents may also identify their children as having Australian ancestry [22]. The diverse characteristics of those reporting Australian ancestry make interpretation of the ‘Australian’ ancestry category complex and underlines why this type of national identity

ethnicity category has been modified or removed from ethnicity classification systems in some countries.

The situation is further complicated in the Australian setting by the use of the word ‘ancestry’ and its inconsistent interpretation by respondents [21]. Some individuals of Anglo-Celtic ethnicity may report Australian ancestry as they connect strongly only to Australian culture as their families have spent generations in the country. In contrast, respondents with likely very similar cultural background may interpret Australian ancestry to only apply to Indigenous Australians. As a result, they may report the origins of their distant ancestors and respond as having English, Irish, or Scottish ancestry. This likely creates artificial distinctions between individuals in society who possess similar migration histories, cultural backgrounds, societal position, and health inequalities related to their ethnicity.

Difference in interpretation could apply to many other groups. For example, individuals with ancestors of Chinese origin who have lived in Australia for one or more generations may strongly identify as being Australian. But as their distant ancestors did not come from Australia, they may respond as having Chinese ancestry only. In contrast, others may interpret the question in terms of their current ethnic identity and select both Chinese and Australian ancestries.

Mixed ethnicity or multiethnic responses

The appropriate categorisation of individuals who report one or more ethnic identities is another important theme in the literature of relevance to Australia. This is a growing population in many countries, including the United Kingdom (UK), New Zealand, Canada, and the United States [33–36]. In the UK, pre-specified collapsed ethnicity groupings are used in the Census, including several mixed ethnicity categories [27]. In contrast, in Australia, New Zealand, and Canada respondents are allowed to report two (Australia, four from 2026) to six (New Zealand and Canada) different ancestries or ethnicities at a high level of granularity [18, 30, 37].

The New Zealand literature provides extensive guidance on approaches to managing multiple responses [33, 38, 39]. The first is a prioritisation approach where an individual is categorised according to only one of their ethnicity responses. Categorisation occurs in order of a pre-specified priority list which gave priority to identifying Māori followed by Pasifika. Though no longer recommended routinely, this is still frequently used in health inequalities research [33]. An advantage of this approach is that it can increase the size of small groups, which may help to increase statistical power and improve identification of inequalities. However, an important disadvantage is that this approach is not based on an individual’s own assessment about which ethnic identity is more important to them, which is of particular importance for Indigenous peoples [33, 40].

The second approach is the total count approach where an individual is counted in each ethnic group they report. Although currently one of the recommended approaches in New Zealand [37] and the most commonly used approach in Australia [15, 41], it is problematic when using data for

causal inference. This is because if individuals report more than one ethnic identity, they and their respective health events are counted more than once in the analysis which can lead to biased estimates of effect. The total count approach is therefore reasonable for descriptive results only. The final approach is the sole/combo approach where those who report only one ethnicity are grouped as that ethnicity. In contrast, those reporting more than one ethnicity are grouped based on that combination. This approach is also recommended in New Zealand [37]. For example, someone reporting both European and Māori ethnicity would be grouped in a multiethnic Māori-European category.

Granularity of ethnicity classification

The third theme in the literature is around approaches to granularity of ethnic groups [42–45] or how to deal with the enormous number of potential ethnic identities. In both the UK and the United States, the use of a limited number of pre-specified ethnicity or racial categories results in limited granularity of data collection. In contrast, in Canada, New Zealand and Australia, data is collected on hundreds of different ethnic groups (>450 in Canada, >200 in New Zealand and >300 in Australia). Both Australia and New Zealand use a geographically based, hierarchical classification system that allows collapsing up of the most granular ethnicity categories into small regional areas and then into large continental areas. However, despite this granularity, government and research publications in these countries commonly use a very limited number of collapsed up categories for reporting. Therefore, there are few examples of how to present granular ethnicity data, despite calls for collecting and reporting increasingly granular categories and to avoid broad-stroke categorisation approaches such as BAME (Black and Minority Ethnic) [46] in the UK and CALD (Culturally and Linguistically Diverse) [14] in Australia. Grouping multiple ethnic groups together this way has the potential to mask important inequalities.

There is commonly substantial community engagement when deciding which ethnicity categories should be included in large data collections such as the Census. However, there is limited, if any, consultation about whether individuals agree or disagree with their allocated aggregated group [47–49]. Additionally, decisions to aggregate several ethnic groups together can be based on assumptions that it is reasonable to combine groups of similar geographical origin and/or physical appearance [47, 50]. However, evidence supports the existence of substantial health differences between ethnic groups that are frequently grouped together [47, 51].

Decisions around categorising multiple groups into a small number of categories are often based on two major considerations: small sample sizes with an associated lack of power to detect statistically significant differences; and the need to reduce the quantity of information presented so that clear research and public policy messages can be made. In terms of the first consideration, the development of methods to combine data from multiple sources together in a meta-analysis means that it may still be valuable to present such data – even if only in an appendix and as long as there is no risk of identity disclosure.

The second consideration around the complexity of messaging, however, remains an important one. It is important to develop methods that allow presentation of sufficient granularity to demonstrate inequalities without overwhelming researchers and policymakers with so much information that key messages are hidden, and decision making is hampered.

Methods

We aimed to develop an approach to using Census ancestry data to determine and categorise ethnicity through a multi-stage iterative process. The development of our approach included the following four steps:

1. Identification of key issues from literature review
2. Data analysis of Census responses
3. Formation of an expert panel with different discipline perspectives
4. Community consultation from an ethnically diverse community panel

The multistage process was iterative, with discussions with the expert panel leading to further literature review and data analysis informing further discussion. We focused particularly on literature from New Zealand given its proximity to Australia and similar history of colonisation of Indigenous Peoples by the British, followed by large scale migration from other countries. We considered literature from the UK, Canada and the United States where relevant. We reviewed Australian literature on the Census ancestry question, including the research and consultation process that led to the development of the question [19], and later criticisms [5, 20–22]. The three main themes identified in the literature that formed the basis of expert panel discussions were discussed in the introduction section. The data analysis of Census responses presented to the expert panel is provided in the online supplementary material. We also present an additional analysis of Australian ancestry responses by age and country of birth of parents in the online supplementary material.

Expert panel members were recruited by snowball sampling. Desirable attributes of panel members included professional and academic expertise in fields such as population health, biostatistics and epidemiology, demography, in-depth knowledge of the Census, and experience working with and representing ethnically diverse groups. The research team initially reached out to known experts in the field, and relevant organisations such as the Federation of Ethnic Communities' Councils of Australia (FECCA) and the Australian Bureau of Statistics (ABS). These contacts suggested other potential members with complementary experience. The final panel comprised: a demographer with expertise in ethnicity (LA); the director of migration data of the ABS (JD); the deputy director of migration data of the ABS (LM); two representatives from FECCA (DC and MAG); an Aboriginal academic (Darkinjung/Ngarigo) (MD); a social worker with expertise in diversity and inclusion and decoloniality (JR); and researchers with experience using linked data to examine health inequalities (NN, MLY). A summary of questions posed to the expert panel and data

presented to inform discussions is provided in the online supplementary material.

In addition to including two representatives from FECCA on our expert panel, we carried out further community consultation from an ethnically diverse community panel. The community panel was formed from those with an interest in health inequalities by ethnicity and/or lived experience of cardiovascular disease (CVD) (as part of the funded project on ethnic inequalities in CVD). We recruited panel members through an expression of interest process through our stakeholders (Local Health Districts and FECCA). Panel members were provided with background information about the project and proposed approaches informed by the expert panel and the literature (see online supplementary material). The lead researcher (FS) met with the panel chair and attended the start of panel meetings as needed to provide explanations and answer any questions. The lead researcher then left the meeting so that discussions and deliberations of the panel could occur independently.

Consensus recommendations

Our four-stage iterative process led to the following four recommendations for how to approach using Census ancestry data to examine health inequalities by ethnicity. Our statistical code for creating ethnicity categories is available for others to use at: https://github.com/linusyd/R-Script-for-Creating-Ethnicity-Groups/blob/main/R_script

Creation of an Anglo-Celtic ethnic majority group

We will create an Anglo-Celtic ethnic group to represent the ethnic majority population in Australia. This ethnic group will be categorised under the European continental category, effectively shifting those identifying as Australian or New Zealander out of the Australian Peoples and New Zealand Peoples categories where they are currently grouped with Indigenous Peoples. This Anglo-Celtic group includes:

(a) Those reporting any combination of English, Scottish, Irish, Welsh (or other smaller UK groupings e.g. Channel Islander) ancestry; (b) Those reporting Australian only ancestry (excluding those who identify as Aboriginal and Torres Strait Islander in the Indigenous status question); (c) Those reporting New Zealander only ancestry; (e) Those reporting any combination of English, Scottish, Irish, Welsh ancestry in addition to a national identity such as Australian, New Zealander, South African, Canadian or American.

Prioritising non-national identities

The Australian Standard Classification of Cultural and Ethnic Groups used by the ABS incorporates many categories that are national identities as well as ethnic groups defined on the basis of a shared culture, language and/or religion that exist within and across nations [31]. Therefore, when individuals report both an ethnic minority group and a national identity, we will prioritise identification with a particular ethnic group within a country or small region over a national identity. For example, someone reporting Chinese and Australian ancestries

or Chinese and Canadian ancestries would be grouped as Chinese. Similarly, someone identifying as Hazara and Afghan would be grouped as Hazara.

Creation of multiethnic groups

For those who report two ancestries not included in the combinations listed above, we will use the combination approach to create a new multiethnic category. Given the enormous number of potential combinations of ethnic groups, we will group combinations at the continent level. For example, someone who reports Chinese and English ancestry would be grouped as multiethnic Asian-European. The exception will be for the Oceania region where we will create multiethnic Māori and Pasifika groups. For example, if an individual reports English and Samoan ancestry they would be categorised as multiethnic European-Pasifika. If an individual reports Chinese and Māori ancestry, they would be categorised as multiethnic Asian-Māori. If an individual reports two different Pacific ancestries (e.g. Samoan and Tongan), we will create a multiethnic Pasifika category. This does not include consideration of New Zealander or Australian ancestry responses which were not considered if other ancestry responses were provided as per recommendation 2.

The reasoning behind this increased granularity of Māori and Pasifika multiethnic groups is: the importance of ethnicity data for these populations who are not identified well by country of birth in Australia [11]; evidence from New Zealand that health inequalities are common in these populations [52]; and the frequent reporting of multiethnic backgrounds in Māori and Pasifika [36].

In relation to terminology, unlike in New Zealand where Pasifika refers to those with Pacific Island origins other than New Zealand thereby excluding Māori, in Australia the term Pasifika or Pacific peoples can include Māori and there is still much ongoing debate about appropriate terminology [50]. In this work, we have kept Māori and Pasifika as separate groups as the different migration experiences of these groups in Australia could have important impacts on health inequalities [50]. In addition, Māori and Pasifika are not classified together in the ABS standard classification of cultural and ethnic groups [31].

Managing granularity

Given the importance of granularity for identifying health inequalities by ethnicity, we will analyse all ethnic groups that are large enough in size to avoid disclosure of identity. This is based on the established ABS rule of having a minimum of ten events reported during the follow-up period. After looking at the age-standardised event rate for each ethnic group with at least ten events, we will collapse up ethnic group granularity using the hierarchical classification system of the ABS [31] to sub-regional groups. We will continue to collapse up further to the continent level, where there is no evidence of poorer health outcomes compared to the population average or important heterogeneity between ethnic groups in a sub-region. This approach avoids assumptions that the health of different ethnic groups from the same region is equivalent. At the same time, collapsing up will reduce granularity where no differences in health are observed between ethnic groups

in a region so that the results presented are simple and easy to interpret. This approach would also allow for provision of more granular results for individual ethnic groups in an online supplementary file or appendix to facilitate meta-analysis. This approach would also mean that rather than using a standard set of ethnicity categories, the categories could differ based on the health outcome under examination.

Example analysis of inequalities in all-cause mortality

We examined the impact of implementing the panel recommendations for ethnicity categorisation on the detection of inequalities in all-cause mortality. Given the importance of identifying health inequalities in Māori and Pasifika which are relatively small population groups in Australia, we also compared the impact on identification of inequalities in mortality based on the single/combination approach and the creation of multiethnic groups (recommendation 3) compared to a prioritisation approach. When using prioritisation, individuals were identified as Māori if they reported Māori ancestry alone or in combination with another ancestry. Similarly, individuals were identified as Pasifika if they reported any Pacific ancestry. We commenced at the most granular group level for Pasifika given evidence of health inequalities between different Pasifika groups [53]. For example, if an individual reported Samoan and English ancestry, based on prioritisation they would be grouped as Samoan. As we did not want to prioritise Māori over Pasifika in Australia, if individuals reported both Māori and Pasifika ancestry we created a multi-ethnic Māori-Pacific category. In addition, for those reporting two different Pacific ancestries (e.g. Samoan and Tongan) we created a multiethnic Pacific category. Other than these two exceptions, multiethnic categories were not created when using the prioritisation approach. We also compared the identification of health inequalities using our approach to other commonly used methods involving (a) country of birth or (b) ancestry – using the total count approach and the ABS classification system with no modifications.

Data source

The demonstration analysis of all-cause mortality by ethnicity was based on the cohort of individuals responding to the 2016 Australian Census who were linked to the Person Linkage Spine (Version 5) by probabilistic data linkage. The Spine is based on the combined population from the following three Commonwealth datasets: the Medicare Consumer Directory (that provides free healthcare to Australian citizens, New Zealand citizens, Australian permanent residents and some other groups); Centrelink Administrative Data (that provides financial support such as unemployment benefits and disability payments); and the Personal Income Tax database. Mortality data was based on registered deaths from the date of the 2016 Census (August 2016) until 31 December 2021. Individual unit-record data were analysed through the secure ABS managed virtual platform known as DataLab. The response rate to the Census was 94.8%. In addition, 89.3% of Census records could be linked to the Person Linkage Spine and

86.0% of deaths could be linked to the Census and the Spine. We used migration data that captures all departures from Australia to censor follow-up time at the date of departure from Australia. We produced age-standardised and sex stratified mortality rates by ethnicity, with 95% confidence intervals. We used the 2001 Australian standard population for standardisation. Statistical analyses were conducted using R software.

As the focus of the present paper is on identifying ethnic inequalities in Australia's non-Indigenous population, we removed from the sample 565,946 individuals who identified as being an Aboriginal and/or Torres Strait Islander person based on the specific Indigenous Status question in the 2016 Census (560,717 persons), those who responded 'no' to the Indigenous Status question but only reported Aboriginal and/or Torres Strait Islander ancestry (1607 persons), those who reported Australian South Sea Islander ancestry (3622), as more than half of this population responded 'yes' to the Indigenous Status question. A flow chart that describes these exclusions is provided in the online supplementary material (Section 3). The final sample for analysis included 20,339,024 individuals.

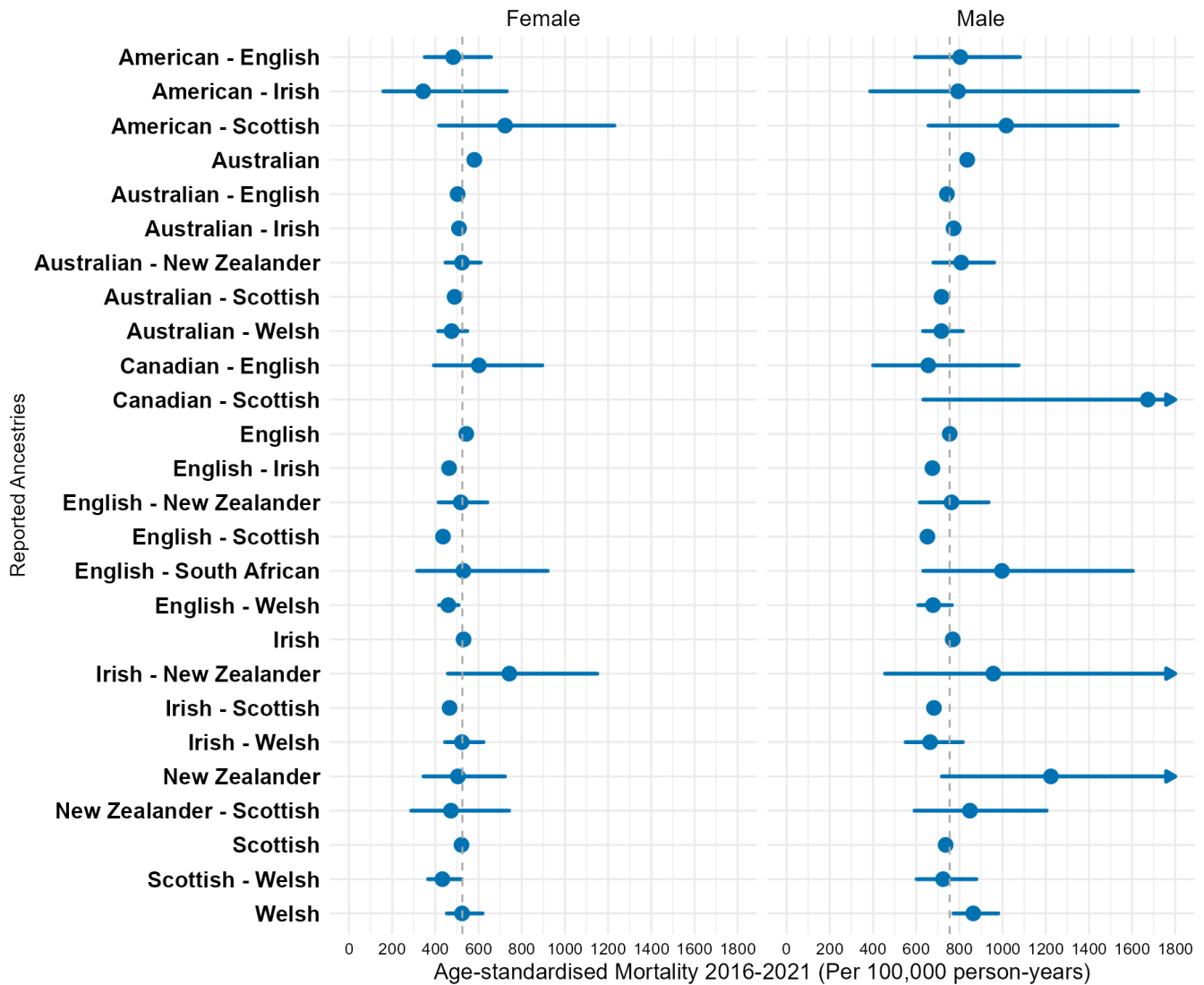
Results

Figure 1 (and Table S1) compares mortality rates among those grouped as Anglo-Celtic (recommendation 1) and demonstrates no important mortality differences between those reporting different combinations of ancestry responses. Any point estimates higher than the mean age-standardised mortality rate for the overall Anglo-Celtic group have wide confidence intervals or differ from the average by only a small magnitude.

Figure 2 shows the impact of prioritising non-national identities (recommendation 2). This Figure shows point estimates and confidence intervals for sex stratified age-standardised mortality for the 30 largest non-Anglo-Celtic ethnic groups in Australia with and without prioritisation of non-national identities. This demonstrates that there is little change to point estimates when ignoring national identities, apart from in Māori males. Further analysis in Māori found that the change in point estimate was largely driven by including those who reported both Māori and New Zealand ancestry, who tended to have lower age-standardised mortality than those reporting Māori ancestry alone, although confidence intervals were wide and overlapped and we did not see this pattern in women (see online supplementary material, Table S2 and Figure S2).

We also considered whether to categorise those reporting South African, Canadian or American ancestry alone as South African European, Canadian European or American European, which is similar to the classification used in New Zealand [37]. To test the impact of this approach on identifying inequalities we conducted a sensitivity analysis where we shifted those identifying as South African alone into the European category. We chose this group as it is a large population group in Australia and could hide inequalities in other Sub-Saharan African groups. However, we found that shifting those identifying as South African alone to the European group did not affect identification of health

Figure 1: Comparison of sex stratified and age-standardised all-cause mortality rate 2016-2021 in those grouped as Anglo-Celtic (n = 11,868,370)



Note: Vertical dashed line refers to the mean age-standardised mortality rate by sex for the overall Anglo-Celtic group (Females: 525 per 100,000 person-years; Males: 755 per 100,000 person-years).

inequalities in the Sub-Saharan African region (see online supplementary material, Figure S3).

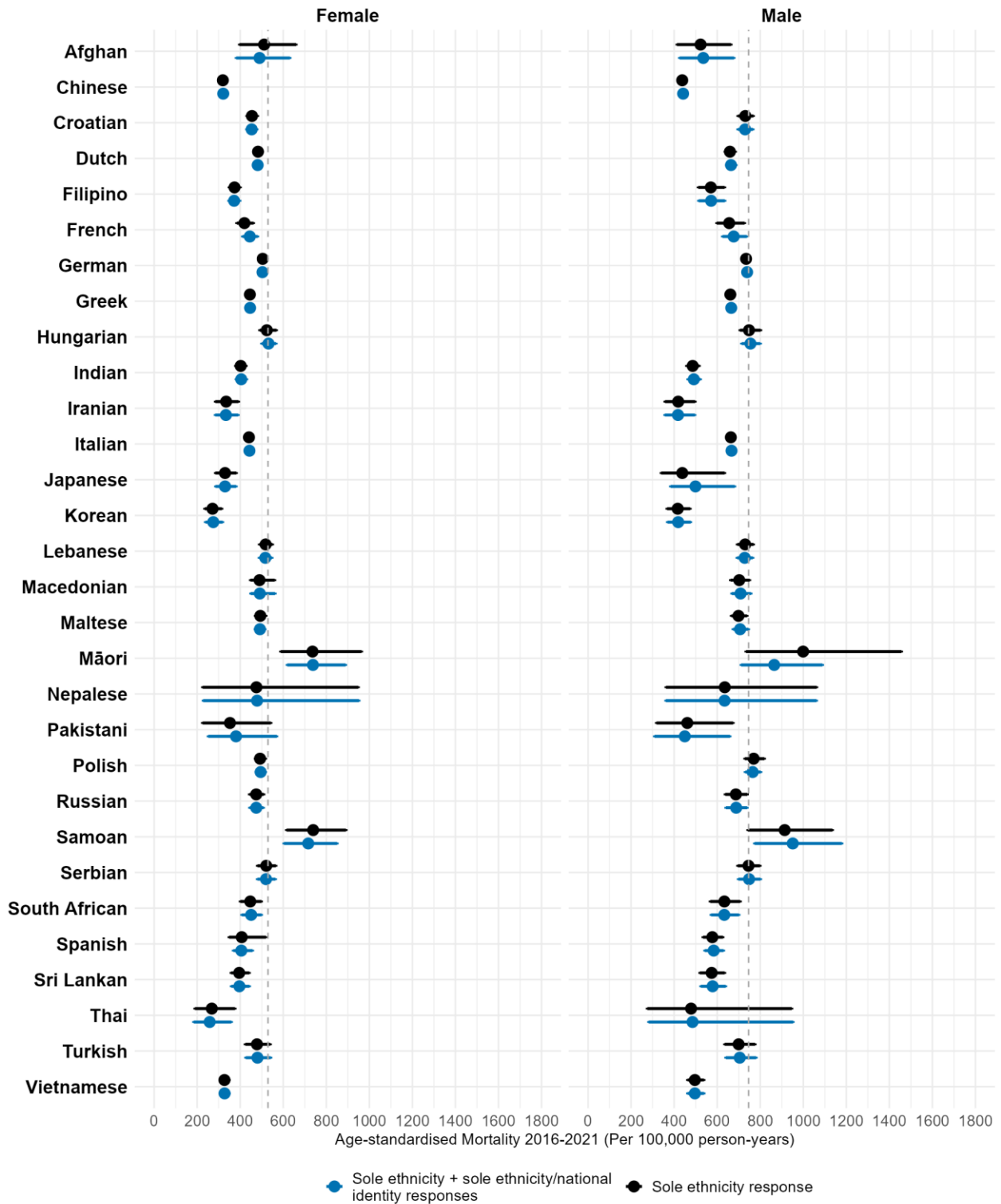
Notably, this approach for ignoring national identities in those reporting two ancestries does not include ‘hyphenated’ identities that are commonly used by established minority communities and are present in the Australian classification of cultural and ethnic groups. Examples include Sri Lankan Tamil and Fijian Indian. There are considerably more of these hyphenated identities in the New Zealand classification including South African Indian and Malaysian Chinese. Unfortunately, we were unable to produce these categories using Australian data as, for example, the absence of a ‘Malaysian’ category makes the Malaysian Chinese combination impossible. When looking at the data for those born in South Africa, we found that of those reporting any Indian ancestry, 77% reported only Indian ancestry and 17% reported both South African and Indian ancestry. It is difficult to know if this represents a difference in identity in these

individuals, a different interpretation of the question, or the lack of a designated South African Indian category. As a result, we only included the hyphenated identities that were listed in the existing ABS classification scheme.

Figure 3 (Table S3) shows all-cause mortality results for Māori and Pasifika contrasting the results for the prioritisation and sole/combination approaches (recommendation 3). This demonstrates a narrowing of confidence intervals when using the prioritisation approach but a shift in point estimates towards the Australian population average in most groups. In some groups, such as Fijian and Tongan males, the use of prioritisation changed a statistically significant higher all-cause mortality into a non-significant difference, despite some narrowing of the confidence interval. The Figure also shows that those categorised as multiethnic Asian-Pasifika or European-Pasifika have lower mortality.

Table 1 (Figure S4) demonstrates the approach to granularity for the health outcome of all-cause mortality

Figure 2: Comparison of estimates of sex stratified and age-standardised all-cause mortality 2016-2021 with and without prioritising minority ethnic identities over national identities

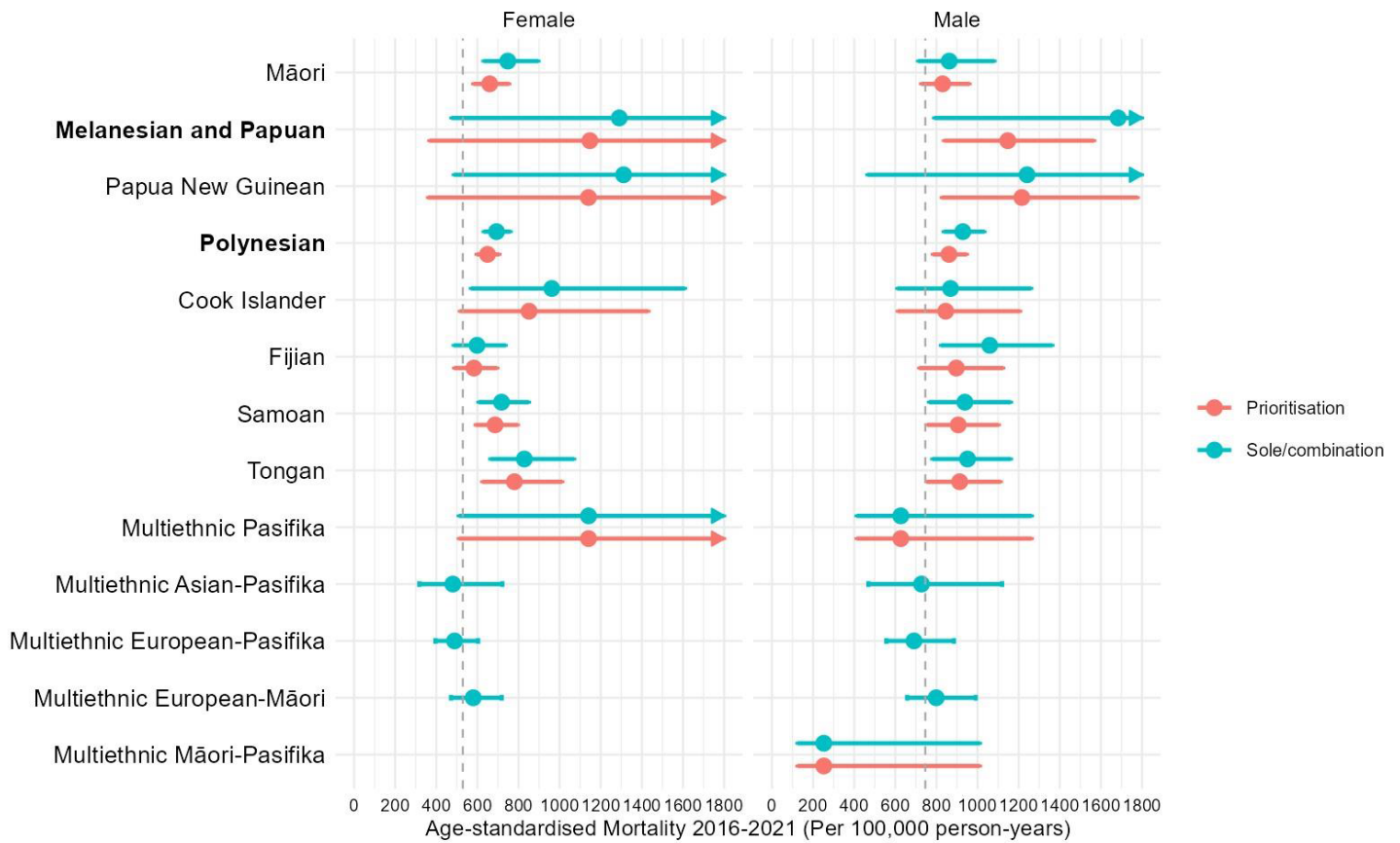


Note: Sole ethnicity response includes only individuals that report this ancestry alone. Sole ethnicity/national identity response includes individuals that report this ancestry alone and those who report this ancestry in combination with a national identity. Vertical dashed line shows the mean age-standardised mortality rate by sex for the study sample. (Females: 526 per 100,000 person-years; Males: 744 per 100,000 person-years).

(recommendation 4). The table shows greater granularity of groups in the Oceania region where although most groups demonstrate significantly higher mortality, there are possible

differences by sex that vary by ethnic group. For example, all-cause mortality appears higher in Fijian males compared to females. In contrast, mortality is higher in females compared to

Figure 3: Comparison of estimates of sex stratified and age-standardised all-cause mortality when using prioritisation or sole/combination approaches for those reporting Māori and Pasifika ancestries



Grouped according to the Australian Standard Classification of Cultural and Ethnic Groups with the addition of multiethnic groups. Groups in bold represent small regional groups and non-bolded groups represent individual ethnic groups in the classification system. Note that Māori are the only group in the New Zealand Peoples small regional category when New Zealanders are grouped as Anglo-Celtic and shifted to the larger aggregate category of European. Note that Fijians are grouped under Polynesians even though they are technically Melanesian as this is how Fijians are currently grouped in the ABS classification. Vertical dashed line indicates mean age-standardised mortality rate for the study sample. (Females: 526 per 100,000 person-years; Males: 744 per 100,000 person-years).

males in other Polynesian groups. However, it is important to note that the confidence intervals around the sex stratified estimates overlap one another. The point estimates for Melanesians and Papuans were very high but confidence intervals were extremely wide due to the small number of individuals in this group. We also observed higher mortality in Finnish males but not in females or in any other European ancestry group. As a result, we collapsed up granularity for the remainder of the European groups into an Other European category. We also reduced granularity in all other regions as age-standardised mortality in all observable ethnic groups was either the same or lower than the population average.

Comparison with existing approaches

Figure 4 demonstrates that country of birth at the small regional level only identifies slightly higher mortality in males born in Northern Europe, and females born in Ireland and Polynesia. No mortality inequalities in Polynesian men were

observed by country of birth and significantly lower mortality was seen in Melanesian and Papuan men. When using the total count approach for ancestry data and the standard classification of cultural and ethnic groups used by the ABS, we identified higher mortality in several groups in the Oceanian region. We identified higher mortality in the same groups using our modified approach to using the ancestry data. However, the inequalities identified were substantially greater in size for many groups. When using our approach with the same small regional categories to facilitate comparison, higher mortality was observed in New Zealand peoples, particularly females (now restricted to Māori), and Polynesians. Moreover, the size of the mortality inequality identified in Polynesian men and women was greater than that identified using the total count approach (693 vs 630 deaths per 100,000 person years in females and 928 vs 853 100,000 person years in males). The estimate of age-standardised mortality was also increased in Melanesians and Papuans using our approach, but the confidence interval was wide and did not reach statistical significance in females. Minimal differences were observed

Table 1: Sex stratified and age-standardised all-cause mortality rate (per 100,000 person-years) by ethnicity in Australia 2016-2021 (n=20,339,024)

Ethnicity	Female		Male	
	ASMR	95% CI	ASMR	95% CI
Māori	747	(629–897)	862	(710–1083)
Melanesian and Papuan	1290	(473–3506)	1684	(789–3518)
Polynesian	693	(630–741)	928	(835–1034)
Cook Islander	962	(568–1610)	869	(610–1261)
Samoa	717	(605–851)	938	(764–1162)
Tongan	828	(663–1071)	951	(780–1162)
Fijian	598	(485–738)	1059	(822–1364)
Other-Polynesian	667	(460–973)	748	(497–1133)
European	516	(514–518)	745	(742–748)
Finnish	587	(526–656)	918	(819–1030)
Other-European	516	(514–518)	745	(742–747)
North African and Middle Eastern	480	(464–497)	662	(642–684)
North American	541	(485–603)	763	(685–852)
Latin American	355	(323–389)	599	(540–665)
Asian	349	(342–356)	475	(466–484)
Sub-Saharan African	428	(398–460)	592	(549–639)

*Mean age-standardised mortality rate was 526 per 100,000 person-years for females and 744 per 100,000 person-years for males. Other European refers to all European ethnic groups apart from Finnish. Other Polynesian includes all other Polynesian ethnic groups whose numbers were too small for results to be presented as individual ethnic groups. ASMR: Age standardised mortality rate.

between country of birth and ancestry measures for other ethnic groups (see online supplementary material Figure S5).

Discussion

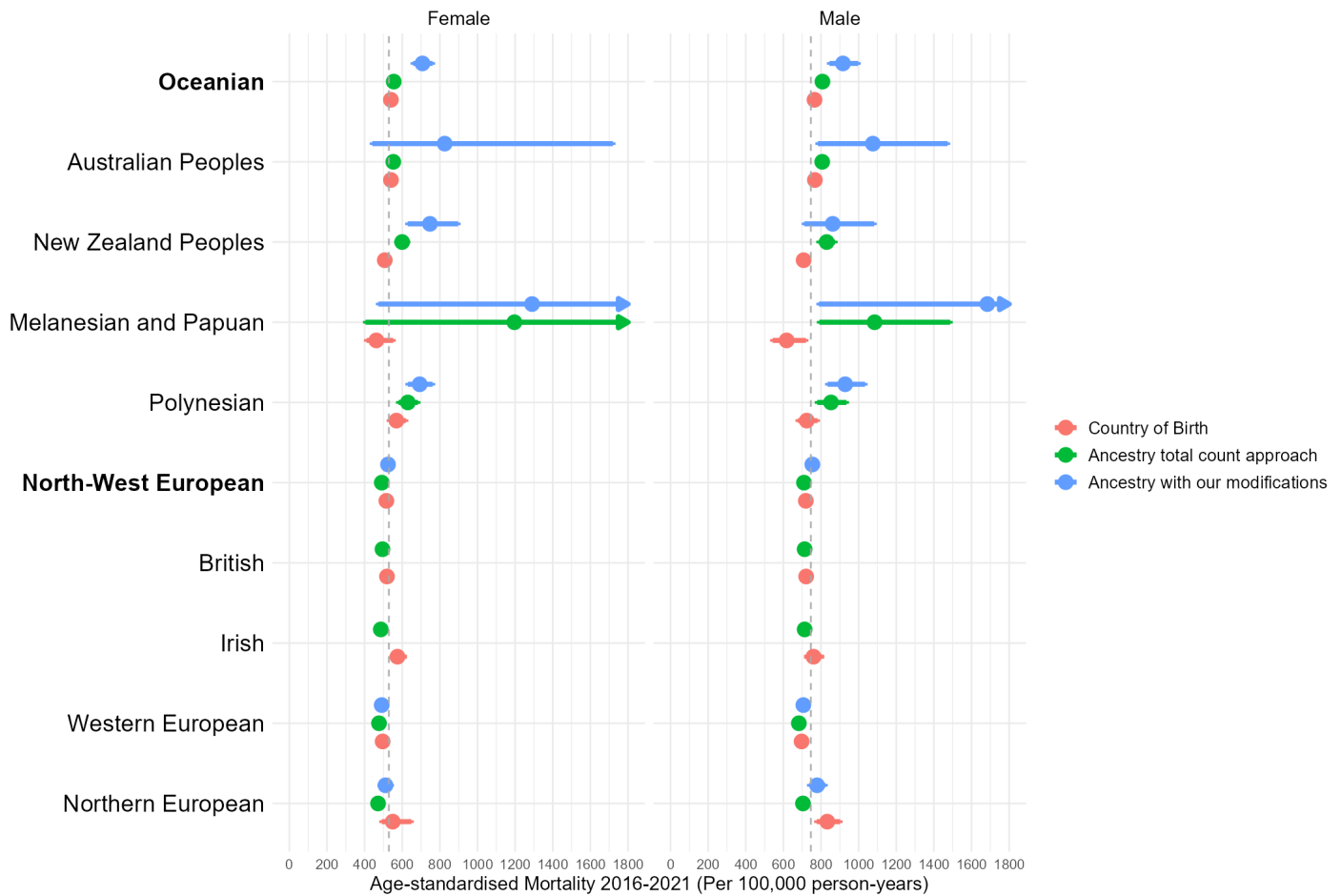
We have presented an approach to using self-reported ancestry data in the Australian Census to group Australia's non-Indigenous population by ethnicity and demonstrated how this approach can be used to identify ethnic inequalities in all-cause mortality. The analyses show the importance of using ancestry data to identify inequalities in Pasifika and Māori. These inequalities are either not identified in the case of Māori or are underestimated in the case of Pasifika when country of birth is used. The identified inequalities were large and of public health significance. We observed mortality rates of 862 per 100,000 person-years in Māori males, 748 in Māori females, 928 in Polynesian males, and 693 in Polynesian females. This compares to the population average all-cause mortality of 744 per 100,000 person-years in males and 526 per 100,000 person-years in females. We also demonstrated that prioritisation approaches in Māori and Pasifika can lead to underestimation of mortality inequalities. However, it seems reasonable to prioritise ethnically minoritised groups within countries over national identities. We also presented an approach for managing the enormous granularity of data collected in the Australian Census without the need to make a-priori decisions about grouping individuals based on their region of origin.

A key strength of our work was the multistage iterative process that we used to develop our approach to ethnicity categorisation. This process involved extensive literature

review and consultation with an expert and community panel. The incorporation of perspectives from community members and different disciplines is essential given the complex nature of ethnicity. A second strength was the application of our approach to linked Census and mortality data from the entire Australian population to examine ethnic inequalities in all-cause mortality. This allowed us to demonstrate quantitatively the impact of our recommendations on the identification of ethnic inequalities. It is important to acknowledge that the collection of ethnicity data and the categorisation of the population into groups is not without risk. Labels given to groups carry assumptions, are not always determined by the groups themselves, and can be reflective of important power differentials [28]. However, population categorisation enables identification of patterns and commonalities in groups that may influence health, including structural inequalities, experiences of discrimination in healthcare settings and reduced healthcare access. There is global evidence of disparities among different ethnic groups in the presence of health conditions, access to evidence-based care and subsequent outcomes [7, 54]. The availability of highly granular ethnicity data is paramount to identifying these disparities, enabling understanding of their drivers [55], implementation of strategies to address these drivers, and subsequent evaluation of the effectiveness of these strategies.

One of the more challenging decisions of the panel was reclassifying individuals to create an Anglo-Celtic group. This included not only those reporting Anglo-Celtic ancestries directly but also those reporting the national identities of Australian and New Zealander. Making decisions to reclassify people is not without risk. Some individuals reporting Australian and New Zealander only ancestry may not be

Figure 4: Comparison of sex stratified and age-standardised all-cause mortality 2016-2021 by country of birth, ancestry (total count approach) and ancestry (our modified approach) for Oceanian and North-West European ethnic groups



Note. Groups are reported in the order they appear in the Australian Classification of Cultural and Ethnic Groups and the corresponding classification of country of birth groups. Groups in bold refer to large regions (level 1) and non-bolded groups refer to smaller sub-regions (level 2). The vertical dashed line shows the mean age-standardised mortality rate for the study sample. (Females: 526 per 100,000 person-years; Males: 744 per 100,000 person-years)

Anglo-Celtic and as a result will be misclassified. However, Census data shows that at present the majority of individuals reporting Australian only ancestry are Australian-born of Australian-born parents and New Zealand research has found those identifying as New Zealanders are largely of European origin [3, 29]. For both groups, there is a high probability of Anglo-Celtic origin due to the largely British migration to Australia and New Zealand prior to the 1950s [20]. It is further supported by findings that ethnic majority persons in settler societies tend to identify with the national identity as they are not 'ethnic' [19]. As the characteristics of those reporting Australian ancestry may change over time, a new approach to resolving this may be needed in future. However, given substantial evidence of health inequalities of Indigenous peoples in our region, the importance of not grouping those identifying with the national identity with Indigenous Peoples remains a key consideration.

A further important limitation in our approach is the assumption that the responses to the question in the Census are indicative of an individual's ethnic identity. Ethnicity is a multifaceted concept and whilst it includes ancestry, not all

those with a particular ancestry will identify as belonging to or feeling connected with a particular ethnic group. However, it is likely that the disconnect between ancestry and ethnicity is greatest for those with a more distant migration history and who have not experienced being minoritized. In Australia this is the Anglo-Celtic population but also likely includes some other European migrants. Similarly, although we are using self-reported data, we have made decisions about how multiethnic groups should be categorised. Although this was done in consultation with an expert and community panel, it may not reflect how an individual might identify.

We have also shown that prioritisation has important limitations when used with Māori and Pasifika as it may mask rather than help reveal inequalities. Using both methods and comparing results may be useful when the impact of prioritisation method on the detection of health inequalities is unclear depending on the sample size and health outcome studied. We did, however, find prioritisation to be useful in terms of simplifying the data without changing the effect estimate when used to prioritise an ethnic minority identity over a national identity. This approach is also consistent

with how such responses are interpreted in other countries. For example, in the United Kingdom the category of Indian ethnicity includes those identifying as Indian and British Indian [27].

Conclusion

We demonstrated an approach to using ancestry data from the Australian Census that improved identification of mortality inequalities in Māori and Pasifika ethnic groups. The observed inequalities are large and of public health importance and are either masked or underestimated when country of birth or the standard approach to ancestry data is used.

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Statement on conflicts of interest

None declared.

Ethics statement

The analysis of unit record data with a waiver of consent was approved by the New South Wales Population and Health Services Research Ethics Committee (2020/ETH01066).

Data availability statement

Data analysed in this paper is not available due to the legislative requirements around access to Census and linked health data. Data is only available to listed researchers on the project who have completed mandatory training in the secure ABS data analysis system known as the DataLab.

Online supplementary materials

<https://osf.io/dga4w>.

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