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Research Article

Projecting the sexual minority population: Methods, data, and illustrative projections for Australia

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Abstract

BACKGROUND
Attitudes to sexual minorities have undergone a transformation in many Western countries in recent decades. With much greater public acceptance, and an increase in policies and legislation to support equality and outlaw discrimination, the need for population statistics on sexual minority populations has grown. However, such statistics remain rare: Only a few sets of population estimates have been produced in a small number of countries, and there are no population projections of which we are aware.

OBJECTIVE
The aims of this paper are to introduce a model for producing projections of a national population by sexual identity, suggest ways in which data and conceptual limitations can be handled, and present illustrative population projections for Australia.

METHODS
An adapted multistate cohort-component is described, along with various data sources and approaches for preparing plausible projection assumptions. Two illustrative scenarios for the future of Australia's sexual minority population over the 2016–2041 period are presented.

RESULTS
According to the selected scenarios, Australia's sexual minority population is projected to increase rapidly over the coming decades, rising from 0.65 million in 2016 to between 1.25 and 1.57 million by 2041. This growth is generated by sexual minority cohort flow – the gradual replacement of cohorts with lower proportions of sexual minority

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identification by those with the higher proportions – and identification change. The overall share of the population identifying with a sexual minority identity is likely to increase.

CONCLUSION
Although the projections remain illustrative and approximate, the likely coming growth of the sexual minority population signals multiple social, health, and economic policy implications ahead.

CONTRIBUTION
The paper presents a novel projection method and example projections of an under-researched and stigmatised population.

1. Introduction

In many Western countries, public attitudes towards sexual minorities have undergone a huge shift in recent decades (Baunach 2012; Flores 2019; Smith, Do, and Kim 2014; Valfort 2017). For example, in the United Kingdom between 1990 and 2010, the National Survey of Sexual Attitudes and Lifestyles revealed a big drop in the percentage of people who believed that same-sex relationships were always wrong – from 50% to 20% (Watt and Elliot 2017). In the US, Gallup opinion polls indicate an increase in support for same-sex marriage from 27% in 1996 to 67% in 2020 (McCarthy 2020). In Australia, a survey in 2004 showed that only 38% of people supported the legalisation of same-sex marriage (Phillips 2010), but by the time of a national plebiscite on the issue in 2017, 62% voted in favour (ABS 2017a). Reflecting these changed attitudes, recent years have witnessed several acts of parliament to prohibit discrimination on the basis of sexual orientation and gender identity, and explicitly provide rights that were previously denied, such as same-sex marriage (Shalley and Wilson 2021).

To monitor equality and changes in the lives of sexual minority populations, it is increasingly recognised that population statistics have an important role to play (Gates 2012; Vizard 2014). In particular, governments, community organisations, and health and social support services would benefit from statistics to inform the development and implementation of policies, programmes, and services that seek to address challenges faced by sexual minority populations. The challenges facing sexual minority populations include stigma, discrimination and abuse (Hatzenbuehler, Phelan, and Link 2013; Meyer and Frost 2013), having and raising children (Perales et al. 2020), disproportionate rates of mental health issues (Perales 2019), higher rates of alcohol, tobacco, and drug use (e.g., AIHW 2020), and the inclusivity of care services for older people (Waling et al. 2019). More specifically, sexual minority population statistics would prove useful as

denominators for demographic and health indicators, benchmarks for monitoring workplace representation, and measures of the demand for goods and services specific to sexual minorities (e.g., same-sex weddings and sexual health services). Reliable population statistics also provide a degree of visibility for sexual minority communities, which is important in overcoming marginalisation.

However, the availability of demographic statistics on sexual minority populations remains limited throughout the world, and most national statistical offices do not publish sexual identity population estimates and projections. One of the notable exceptions is the UK Office for National Statistics, which produces experimental sexual identity population estimates each year based on the results of its large Annual Population Survey (ONS 2020). Some statistical offices publish numbers of same-sex couples derived from census or survey questions on gender and relationship in household (e.g., ABS 2018a; Statistics Canada 2017; US Census Bureau 2019), though they only cover the subset of the sexual minority population who are in cohabiting same-sex relationships, and will therefore be undercounts. Those countries which allow same-sex marriage, such as France, New Zealand, and Australia, publish statistics on same-sex marriage and divorce (e.g., Meslay 2019; Statistics New Zealand 2020; Shalley and Wilson 2021). In addition, in several Western countries some large representative surveys ask a question on sexual identity (e.g., ABS 2015; Carpenter 2013; Chandra, Copen, and Mosher 2013; Statistics New Zealand 2019; Valfort 2017), allowing researchers to calculate population estimates as well as analyse characteristics of the population by sexual identity, such as health and wellbeing (e.g., Perales 2019). Survey data has been employed by researchers to prepare sexual minority population estimates for a small number of countries, including Australia, Canada, and the United States (e.g., Gilmour 2019; Prestage et al. 2008; Conron and Goldberg 2020; Wilson et al. 2020).

Projections of sexual minority populations could also be useful for many of the same purposes as population estimates. They would provide advance notice of coming demographic changes, enabling organisations to plan ahead for a growing and ageing sexual minority population. This is particularly important given that sexual minority populations are likely to face a range of unique challenges in older age in addition to those experienced by their heterosexual counterparts, such as cultural or stigma-related barriers to accessing services (Alba et al. 2020). Although the data environment for such projections is far from ideal, we argue that it should still be possible – for a few countries – to formulate plausible scenarios and create projections indicating the broad direction of change that can be expected in coming years. To the best of our knowledge there is currently no existing literature on projections of population by sexual identity. The aim of this paper is therefore to present a model for projecting populations by sexual identity, and illustrate its use with projections for Australia over the period 2016–2041, with a focus on the sexual minority population.

Following this introduction, we review possible methods and data for creating sexual identity population projections, drawing primarily on the literatures covering ethnic group modelling and sexual identity. Then we describe the projection model created for this study, and outline the assumptions of the selected projection scenarios. Results are presented in the next section followed by a discussion of the modelling and policy implications of our work. We finish with some concluding remarks and suggestions for further research.

2. Methods and data for projecting the sexual minority population

2.1 Defining the sexual minority population in this study

Before discussing input data and projection methods, it is important to specify exactly what we mean by the 'sexual minority population' for the purposes of this paper. Sexual orientation is often considered to possess three elements: (1) sexual attraction, referring to sexual feelings, (2) sexual behaviour and sexual activity, and (3) sexual identity, referring to how someone labels their sexuality (Durso and Gates 2013). That said, some scholars have specified additional elements of sexual orientation. For example, Bogaert (2012) suggests an additional four elements, including romantic attraction, sexual arousal, genital stimulation, and desire. However, most surveys focus on sexual identity, and in some cases sexual behaviour or sexual attraction. Surveys have shown considerable differences between the numbers of people reporting any same-sex sexual attraction, any same-sex sexual behaviour, and minority sexual identity (e.g., Geary et al. 2018; Richters et al. 2014). This study specifically examines sexual identity because the sources of available data focus on this dimension of sexual orientation. In this paper we refer to the sexual minority population in relation to identity, but acknowledge that there are numerous components to sexual orientation. We include those who define their identity as lesbian, gay, bisexual, and other minority identities such as queer or pansexual, based on the categories used in the available data. Excluded are those who described themselves as heterosexual or who replied 'don't know' or 'rather not say'.

Surveys which include questions on sexual identity are asked in many Western countries (e.g., ONS 2020, Newport 2018; Statistics New Zealand 2019). In Australia, a few nationally representative population surveys have collected data on sexual identity, including the General Social Survey (ABS 2015), the Australian Study of Health and Relationships (Smith et al. 2003; Richters et al. 2014), and the Household, Income and Labour Dynamics in Australia (HILDA) Survey (Wilkins 2015; Wooden 2014). These surveys suggest that between 3.0% and 4.5% of adults comprise the sexual minority population based on their stated sexual identity (Wilson et al. 2020).

It is important to underline the fact that sexual identity data represent a simplified (and sometimes imprecise) indication of an individual's sexual orientation. A person's sexual identity can be complex and multi-layered, and it may vary over time (Allen 2016; Campbell, Perales, and Baxter 2020; Diamond, Dickenson, and Blair 2017). The survey instrument used to collect sexual identity information acts as a 'statistical filter' of this more complex reality. The general survey environment can affect the willingness of a participant to respond to the question or the answer they choose to give. Not all individuals who experience same-sex attraction and sexual activity will report a sexual minority identity in a survey (Gates 2012). Of particular importance is the respondent's degree of ease with the circumstances of the survey, which may depend on the survey mode (e.g., face to face or self-completion questionnaire), the characteristics and attitude of the interviewer, and the degree of privacy (e.g., whether or not other people are present) (Durso and Gates 2013). The wording of survey questions is also important, and responses may vary according to the chosen survey terminology, respondents' understanding and interpretation of this terminology, and the sexual identity categories participants are asked to choose from (Weinrich 2014). In addition, all sample surveys experience sampling and non-sampling errors. Thus, sexual identity data vary between surveys, and because of reluctance by some to report a sexual minority identity, are likely to under-represent the sexual minority population to some extent.

2.2 Projection modelling options

The challenges in projecting sexual minority populations are considerable, and include the dearth of existing literature and projection models, the complexity and sensitivity of sexual identification, and a limited data environment. Given the requirement of age and sex details from many users in population projections, and the variation in sexual minority populations by age and sex, some form of cohort-component model is necessary. But what types of cohort-component model might be considered? Guidance is offered by the theoretical frameworks of multistate demography (Ledent and Zeng 2010) and population accounting (Rees and Willekens 1986) and existing work on projections by ethnic group, country of birth, Indigenous status, and other social groups (e.g., Rallu 2017; Rees et al. 2012; O'Donnell and Raymer 2015; Wilson 2016).

Where the proportions of the population identifying as part of the sexual minority population by gender and age group are available from a recent survey, a simple approach would be to take an existing population projection by age and gender and apply these proportions. This is a participation-ratio (or simply ratio) type of model (Smith, Tayman, and Swanson 2013), which is sometimes used to prepare labour force projections (e.g., ILO 2017), small area population projections (e.g., Hachadoorian, Gaffin, and Engelman

2011; Smith, Tayman, and Swanson 2013), and living arrangement and household projections (e.g., Cooper, Bell, and Les 1995), amongst others. Although probably empirically adequate for a short-run projection for a few years ahead, this approach contains drawbacks because it implicitly assumes sexual identity is a function of age and gender only, and fails to incorporate cohort progression and identification change occurring over time. If sufficient data were available, an age-period-cohort model of the proportions could be applied. But all these options possess conceptual limitations. By simply disaggregating the projected population according to sexual identity proportions, they fail to model actual demographic processes.

A conceptually better approach would be to estimate the population by sexual identity categories by age and gender for a recent date, and then apply a cohort-component model. This is the type of model often employed for projections of population by ethnic group and First Nations peoples (e.g., Lomax et al. 2020; Temple et al. 2020). But much more data is required. The easiest option would be to estimate populations for just two categories, heterosexual and sexual minority. Estimates of recent fertility, mortality, migration rates, and identification change rates would then have to be obtained, or indirectly estimated, for these populations, and assumptions made about their future direction. Some cohort-component models for multiple population groups use net migration and net identification rates or flows, while others, applying the principles of multistate demography (Ledent and Zeng 2010), explicitly include directional rates. The multistate approach is preferable on conceptual and practical grounds, but in order to calculate identification change rates it requires sexual identification change data, which is rare and, where available, tends to be based on small sample sizes.

The above methods are relatively straightforward for most age groups, but how young children are included in projections of social groups defined by identity can be more complex and sensitive. This is particularly the case where the mother and father of a child identify differently. In ethnic group population projections, newly born infants are modelled in a variety of ways. They may have the same ethnicity as their mothers, be assumed to be of minority identity if either the mother or father has a minority identity, or be distributed across multiple ethnicities from a matrix based on the ethnicity of the mother, or ethnicities of both mother and father (e.g., Coleman 2010; Wilson 2016), while in some models they are assumed to form a 'multiple origin' category (e.g., Edmonston, Lee, and Passel 2002). Another option is not to assume any particular classification for young children. Writing in the context of ethnic group population modelling, Sporton and White (2002: 83) proposed that "If we accept that ethnicity is a social construction, then it can be argued that a newborn child does not have an ethnicity". Such an approach would seem appropriate for sexual identity, given its typical emergence during adolescence and young adulthood (Mustanski, Kuper, and Greene 2014).

2.3 Population estimates

All population projections require launch-year or 'jump-off' population estimates. Sexual minority population estimates for the adult population of Australia by sex and six broad age groups for the 30th June in 2011 and 2016 were estimated by Wilson et al. (2020), updating earlier estimates prepared by Wilson and Shalley (2018). The latest estimates were calculated by multiplying averaged sexual minority population proportions from three large nationally representative survey datasets by ABS Estimated Resident Populations (ERPs) for 2011 and 2016. ERPs for years ending in 1 and 6 are the most reliable because they are based on census enumerations for those years (with some upward adjustment for census undercount). The sexual minority population estimates have some limitations because they are based on sample survey data, but are the best statistics currently available. For population projections the broad age ranges will need disaggregating into smaller age groups. For a few other countries, including the United States and the United Kingdom, similar sexual minority population estimates are available (e.g., Conron and Goldberg 2020; ONS 2020).

2.4 Mortality

Unfortunately, official data on mortality by sexual identity are not available. In ethnic group population modelling where mortality data are not directly available, researchers have been able to indirectly estimate mortality from other data sources. For example, Rees and Wohland (2008) create ethnic group mortality estimates for the UK by making use of a census question on long-term illness. They estimate Standardised Mortality Ratios and Standardised Illness Ratios for local authorities and use the relationship between them to estimate ethnic group mortality from ethnic-specific Standardised Illness Ratios. But for sexual minority populations there is insufficient data to apply a similar approach because sexual identity has yet to be included in the Australian census, and there is no direct census question on self-assessed health. If sexual identity was asked in the census, it would then be possible to link census records and records of subsequent deaths, as the Australian Bureau of Statistics has done for the Indigenous population to provide more accurate Indigenous mortality estimates (ABS 2018b).

International research indicates that sexual minority population mortality is likely to be higher than that of the heterosexual population. Several studies have demonstrated an above-average suicide risk in Australia (e.g., Skerrett, Kõlves, and De Leo 2015; Swannell, Martin, and Page 2016) and internationally (e.g., Marshal et al. 2011; King et al. 2008), though the impact on life expectancy at birth is likely to be small. Survey data for Australia show higher rates of smoking, drug use, and obesity in the sexual minority

population, which are key risk factors for higher mortality (Wilkins 2015). Household, Income, and Labour Dynamics in Australia (HILDA) is a large panel survey interviewing about 17,000 people each year that has asked a question on sexual identity across several waves. Its findings reveal that people identifying as a sexual minority smoke to a greater extent than people identifying as heterosexual. In the 2012 HILDA wave, amongst those aged 15 years and older, 34% of sexual minority men smoked compared to 20% for heterosexual men, while for women the equivalent figures were 27% (sexual minority) and 15% (heterosexual) (Wilkins 2015). A lower proportion of sexual minority men were obese than heterosexual men, but the opposite was the case for women (Wilkins 2015). It is also well established that sexual minority populations, especially those identifying as bisexual, experience poorer health outcomes across many measures of physical and mental health (Perales 2019).

Overall, the literature points to higher mortality amongst the sexual minority population, but a robust population-wide quantitative estimate remains unavailable. Our approach is to use national mortality rates for both sexual minority and heterosexual populations in our projections, while acknowledging the approximation in doing so. In the Appendix to this paper we also report a sensitivity analysis where life expectancy at birth varies by 5 years either side of the national average (a variation which is probably beyond any likely difference in national life expectancy experienced by the sexual minority population). It demonstrates relatively little impact of this amount of variation in life expectancy on projected population numbers.

2.5 International migration

Very little data on international migration flows by sexual identity are available. The General Social Survey (ABS 2015) asks questions on both sexual identity and immigrants' year of arrival in Australia, though the sample size is too small to obtain a reliable indication of migration levels. The Australian census asks for individuals' usual address on census night one year ago and five years ago (ABS 2017b), so those living overseas one or five years ago are counted as immigrants. Census immigration data can be obtained for individuals in a same-sex couple relationship. According to the 2016 census, of the 1.3 million people who were living overseas 5 years earlier, 8,700 persons were in a same-sex relationship at the time of the census (ABS 2020). Unfortunately, this figure only refers to the cohabiting same-sex partnered population, representing a substantial undercount of the sexual minority population overall, and is only available for immigration flows (not emigration), so the data are of limited use.

It is probable that the sexual minority population is well represented in Australia's immigration intake. Australia is an attractive migration destination generally (Tuccio

2019), but particularly so for sexual minority populations (Yue 2013). Neoclassical migration theory suggests that people migrate to improve their income or wellbeing (de Haas 2014), and for some origin countries the wellbeing discrepancy with Australia for sexual minority populations is substantial. Flores (2019) lists Australia as 20th out of 174 countries for the social acceptance of these populations, and the International Lesbian, Gay, Bisexual, Trans and Intersex Association classifies Australia as having "broad protection" against sexual orientation discrimination (ILGA 2019). Since 1991, Australian citizens and permanent residents have been able to sponsor an overseas same-sex partner for immigration to Australia (Shalley and Wilson 2021). Laws ban discrimination against same-sex couples and their families in the provision of federal government services (Same-Sex Relationships Act 2008), discrimination on the basis of sexual orientation was outlawed in 2013 (updating the Sex Discrimination Act 1984), and same-sex marriage was introduced in 2017 (Marriage Amendment Act 2017). Due to data limitations, our approach is to assume that the sexual minority population experiences immigration and emigration at the same rate as the heterosexual population.

2.6 Identification change

Early work on sexual identity development assumed that minority sexual identities developed in a number of stages, starting with feeling different, through gradual realisation of same-sex attractions, and ending with acceptance, by which time sexual identity is fixed (Diamond 2006; Katz-Wise 2015). It is now accepted that reality can be more complex and that sexual identity may develop differently, and be reported differently, over time.

A limited number of surveys indicate an increase in the proportion of people reporting a sexual minority identity in recent years. The Australian HILDA survey indicates that 3.3% of the adult population described themselves with a sexual minority identity in 2012 but 4.1% did so by 2016 (Wilson et al. 2020). UK survey data reveals that the percentage of people reporting themselves as lesbian, gay, bisexual, or 'other' rose from 1.9% in 2014 to 2.9% in 2018 (ONS 2020). The Gallup survey in the US found that the share of the US adult population identifying as lesbian, gay, bisexual, or transgender increased from 3.5% in 2012 to 4.5% by 2017 (Newport 2018) (although it should be noted that this group also included people who were transgender, some of whom identify as heterosexual). Common to these countries are higher proportions identifying with a sexual minority identity in the younger adult ages.

While these surveys indicate changes in identification in the adult population overall, there is less evidence on the relative contributions of cohort effects (e.g., where younger cohorts have higher sexual minority population proportions that are maintained

as they age over time), age effects (e.g., where people are less likely to report a minority identity as they get older), and period effects (e.g., where a larger proportion of people at all ages report a sexual minority identity). Proportions of the Australian population reporting a sexual minority identity from the HILDA surveys in 2012 and 2016 hint at a slight period effect and a sizeable cohort effect (Wilson et al. 2020). The findings from several surveys conducted by Roy Morgan Research (2015) between 2006 and 2014 also suggest period and cohort increases in identification in Australia. In the US, the increase in the proportion of people identifying as lesbian, gay, bisexual, or transgender reported by Newport (2018) was wholly driven by increasing identification in younger cohorts. Analysing sexual behaviour data from the US General Social Survey, Mishel et al. (2020) found strong cohort differences in same-sex sexual behaviour, with younger cohorts far more likely to report this behaviour. The cohort increase was greater for women than men. However, more data and research on these trends is required before any firm conclusions can be drawn about cohort, period, and age effects.

Ideally, changes in sexual identity over time would be measured and analysed using longitudinal survey or census microdata. However, reflecting the limited data environment, relatively few studies have been able to achieve this (e.g., Campbell, Perales, and Baxter 2020; Dickson et al. 2013; Mock and Eibach 2012; Ott et al. 2011). Some (but not all) suggest greater fluidity in female sexual identity (e.g., Katz-Wise 2015), and less stability in bisexual identities than other sexual minority identities. While these studies offer useful discussions of changes in sexual attraction and identity over time, the samples of sexual minority populations are generally too small to provide robust estimates of identification change rates by age and gender. We base our identification-change-rate projection assumptions on the small number of persons reporting a different sexual identity over time in the HILDA survey.

2.7 Fertility

As noted earlier, the simpler option is to project births for the female population as a whole, as is done in a standard cohort-component model, and allocate babies to the childhood population. This is the approach we take. All those aged under 18 in our projections comprise the childhood population; sexual identity is not modelled for this group. Attempting to project births by the sexual identity of women would be the more complex option and would present some data estimation challenges. The ethnic-group projections literature includes a number of examples, though data availability is generally better for ethnic groups (e.g., Norman, Rees, and Wohland 2014; Sporton and White 2002) and there is often an intergenerational transfer of ethnicity which does not apply to sexual identity.

3. Data and methods

3.1 Projection model

We created a cohort-component projection model based on multistate principles to prepare sexual identity population projections. It was designed using a movement population accounting framework (Rees 1984). For the adult population, the accounting equation is similar to that for ethnic group or Indigenous projections. For any period-cohort it may be expressed as:

$$P^{i}_{s,a+1}(t+1) = P^{i}_{s,a}(t) - D^{i}_{s,a\to a+1} + I^{i}_{s,a\to a+1} - E^{i}_{s,a\to a+1} + \sum_{j,j\neq i} M^{ji}_{s,a\to a+1} - \sum_{j,j\neq i} M^{ij}_{s,a\to a+1} \quad (1)$$

where P denotes population, i and j sexual identities, D deaths, I immigration, E emigration, M mobility from one sexual identity to another, s sex, a age, t time, and $a \to a+1$ the changing age of the period-cohort from a to $a+1$ over the one-year t to a $t+1$ projection interval. Time labels for the demographic components are omitted from the equation for clarity. In the application for Australia, just two population categories are distinguished among the adult population (sexual minority, heterosexual), but in theory more sexual identities could be modelled if necessary (e.g., lesbian/gay, bisexual, other, heterosexual, and unsure).

Each of the demographic components in the equation above is projected as the product of an occurrence/exposure rate and the number of person-years at risk. For example, deaths are calculated as:

$$D^{i}_{s,a\to a+1} = d^{i}_{s,a\to a+1}\ \tfrac{1}{2}\left(P^{i}_{s,a}(t) + P^{i}_{s,a+1}(t+1)\right) \quad (2)$$

where d refers to the death rate. Following Rees (1984), the calculations are programmed in an iterative procedure. This allows the end-of-interval populations to remain on the right-hand side of the equation because they are updated in successive iterations.

Sexual identity is not considered before age 18, so all those aged 0–17 form the childhood population c. The accounting equation for this population is:

$$P^{c}_{s,a+1}(t+1) = P^{c}_{s,a}(t) - D^{c}_{s,a\to a+1} + I^{c}_{s,a\to a+1} - E^{c}_{s,a\to a+1} \quad (3)$$

As individuals turn 18, they are assumed to adopt either a heterosexual or sexual minority identity. Obviously, this is a simplification of reality. Individuals do not suddenly switch from having no sexual identity at age 17 to a clear sexual identity at age 18. The process of identity formation will vary from person to person, occurring at different speeds over different ages. However, given the limited available data and knowledge, this simplification was chosen for modelling purposes at present. At age 18 the childhood population is multiplied by a sexual identity proportion:

$$P^{i}_{s,18}(t+1) = P^{c}_{s,18}(t+1)\ p^{i}_{s,18} \tag{4}$$

where p refers to the proportion of the population of sexual identity i. These sum across identities i to unity.

Births do not need to be projected by the sexual identity of women because our projection model only requires the number of male and female babies born each year. These newly born infants then join the childhood population. The model projects births for the national population as a whole in the standard way:

$$B = \sum_a \left(b_a \ \frac{1}{2}\left[P_{f,a}(t) + P_{f,a}(t+1)\right]\right) \tag{5}$$

where B denotes births, b the age-specific fertility rate, and subscript f female. Births are split into female and male babies using an assumed sex ratio at birth (105.5 male babies per 100 female babies).

3.2 Input data and projection assumptions for Australia

The sexual minority jump-off populations for 30th June 2016 were estimated by taking the population estimates by gender and broad age group created by Wilson et al. (2020) and disaggregating them to single years of age. The proportions of the population in each broad age–gender group reporting a sexual minority identity were interpolated to single years of age, multiplied by official Estimated Resident Populations (ERPs), and then adjusted slightly to be consistent with the estimates by broad age–gender group. Heterosexual populations were created as the national ERPs minus the sexual minority estimates. The childhood jump-off population consisted of the 2016 ERPs.

The Total Fertility Rate (TFR) was assumed to experience a temporary dip due to the COVID-19 recession, followed by some modest recuperation. The long-run TFR was set at 1.65. Life expectancy at birth for all population groups was assumed to increase, with female life expectancy rising from 84.9 years in 2016–2017 (the first projection interval, from 1 July 2016 to 30 June 2017) to 88.8 years by 2040–2041, and male life

expectancy from 80.0 years in 2016–2017 to 86.3 years in 2040–2041. International migration was assumed to drop dramatically due to the temporary closure of the Australian border as a COVID-19 protection measure and the COVID-19 recession. Immigration flows were allocated between sexual minority and heterosexual populations on a proportional population basis, while all population groups were subject to the same emigration rates. Immigration and emigration flows are constrained in the projection programme to an overall net-migration-total assumption. Net international migration was assumed to fall from the observed value of 263,000 in 2016–2017 to –25,000 in 2020–2021 before recovering to 225,000 per annum from 2025–2026 onwards.

To create assumptions about identification change between heterosexual and sexual minority populations, we extracted data on sexual identity changes between 2012 and 2016 from the HILDA survey. Table 1 presents a cross-tabulation of the number of HILDA survey participants by reported sexual identity at the two survey waves (unscaled and unweighted survey data shown). The sexual minority population in HILDA is defined as those describing themselves as gay, lesbian, bisexual, or other. The table shows a non-trivial amount of identification change occurring over the four-year interval, and net identification gains to the sexual minority population.

Table 1: Sexual identification changes 2012–2016, as measured by the HILDA survey, Australia

		2016		
		Heterosexual	Sexual minority	Total
	Women			
2012	Heterosexual	5,976	95	6,071
	Sexual minority	75	149	224
	Total	6,051	244	
	Men			
	Heterosexual	5,233	70	5,303
	Sexual minority	34	119	153
	Total	5,267	189	

Source: HILDA survey.
Notes: Sexual minority is defined here as the population describing themselves as gay, lesbian, bisexual, or other, according to the categories used in the HILDA survey. Unweighted original survey counts shown.

However, it is important to be aware, as noted earlier, that these data are derived from answers to survey questions. After passing through the 'statistical filter' of the survey collection instrument, they form approximate representations of a more complex reality. Some identification changes may be due to a person's continuing sexual identity development, or the emergence of a previously unrecognised aspect of their sexuality (Campbell, Perales, and Baxter 2020). For others, an apparent identification change may be due to a change in circumstances, such as a move into an aged-care facility where an individual no longer feels comfortable disclosing a minority sexual identity (e.g., Lyons et al. 2020), or a younger person's move out of the family home which enables them to

be more open about their sexual identity. Other people may not strongly identify with any of the commonly presented sexual identity categories, and might choose different answers to the sexual identity question depending on the context (Galupo, Ramirez, and Pulice-Farrow 2017).

Using the HILDA identification-change data, we calculated annual rates of changing from sexual minority to heterosexual, and heterosexual to sexual minority, by gender and five-year-age-group period cohorts. Given the small numbers involved, the age patterns were, unsurprisingly, very noisy, and we applied smoothing across age using cubic splines. For both men and women there is a clear pattern of high rates of change from heterosexual to sexual minority at the young adult ages, which drops rapidly with rising age. The age pattern of identification change from sexual minority to heterosexual was unclear for men so we assumed a constant average rate by age; for women, there was an apparent increase in identification change at the older ages. Figure 1 illustrates the identification-change rates.

During the running of the projection model with identification-change rates held constant we discovered that net identification gains to the sexual minority population became negative about 12 years into the projection horizon. This was due to the rapid growth of the sexual minority population, which produced increasingly large flows out to the heterosexual population. This did not seem plausible and is analogous to multi-regional projection models generating implausible net migration values over time (e.g., Dion 2017; Wilson and Bell 2004). In the scenarios and variants which include identification change, we therefore adjusted the identification-change rates over time by constraining to a total net identification-change amount, which fell from a net gain to the sexual minority population of 16,270 in the first projection year (the value generated in the constant-rates projection) to zero by the end of the projection horizon. We assume, therefore, that net gains to the sexual minority population reduce over time as society becomes more accepting, so that an increasing proportion of people experiencing same-sex attraction report a sexual minority identity from a young age. But the exact assumption is judgment-based, and remains very much a scenario.

Figure 1: Sexual identity identification-change rates by gender and age

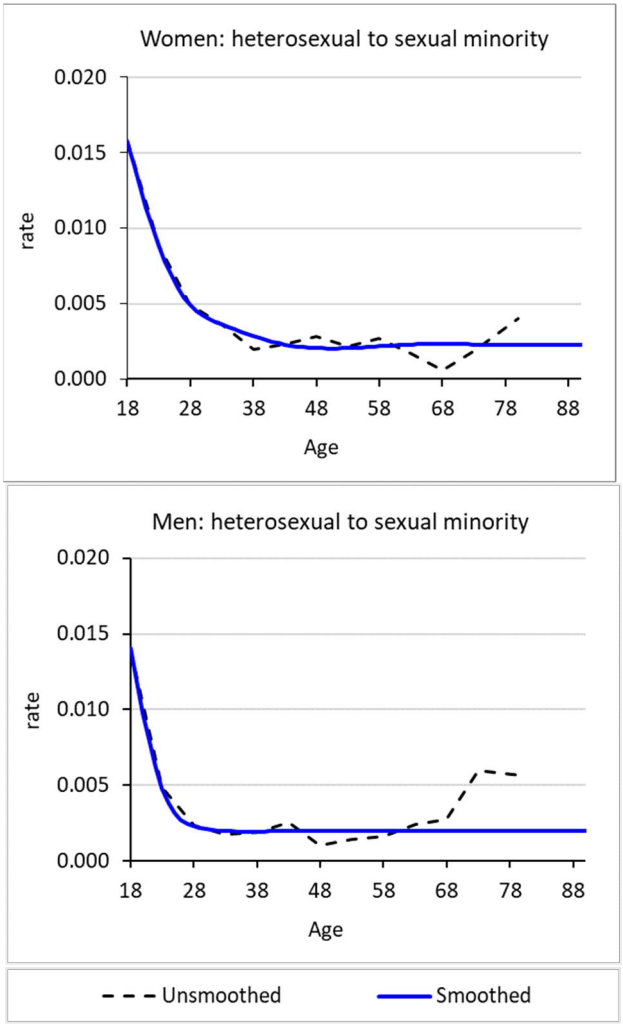
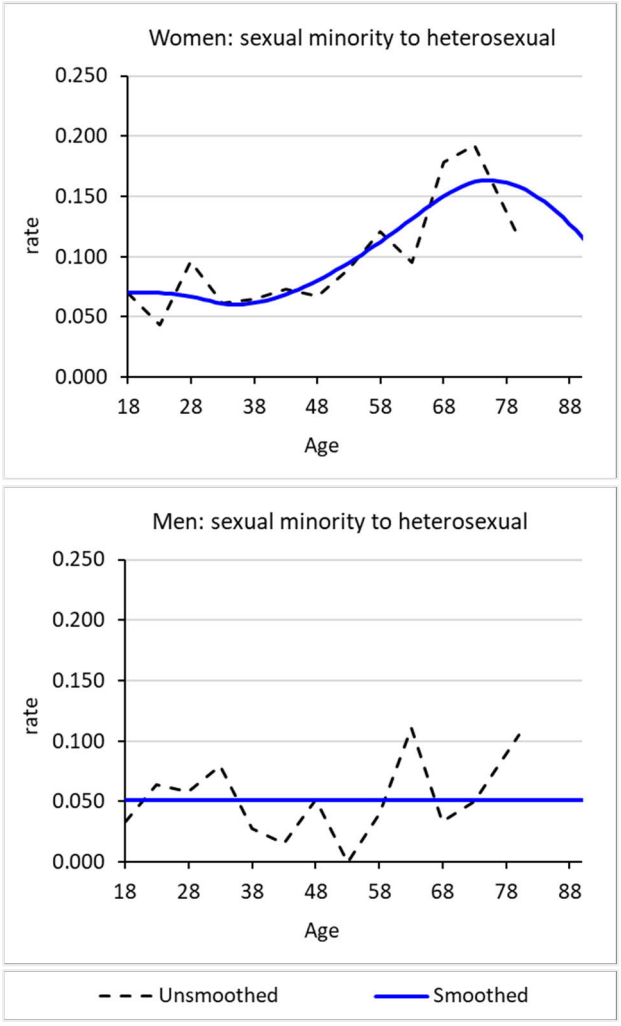


Figure 1: (Continued)



Note: Age is shown as the mean age of each period-cohort.
Source: Calculated from HILDA survey data 2012 and 2016.

3.3 Projection scenarios

Two projection scenarios were created, which varied only in their identification-change assumptions: the same fertility, mortality, and migration assumptions were used for both sets of projections. The limited data and previous research on sexual identity demographic change prevented us from formulating robust and precise assumptions. Instead, scenarios were created by considering plausible future trajectories for the sexual minority population. We defined the scenarios as follows.

1) **Low Scenario**: No further cohort increases in identification and no identification change above age 18. In this scenario, cohorts reaching adulthood adopt a sexual minority identity to the same extent as the population aged 18–24 in 2016. We assume no change in the sexual minority proportion at age 18 during the projection horizon and no identification-change flows over time at other ages.
2) **High Scenario:** Continued cohort and period increases in identification, and age-varying changes in identification. In this scenario, younger cohorts grow up in increasingly accepting times, and there is a gradual rise in the proportion of young adults reporting a sexual minority identity as they reach age 18. We assume an increase in sexual minority proportions at age 18 of 0.019 per decade for both men and women until the proportions reach 0.1, where they are capped. This increase in sexual minority identification at age 18 is the change between 2012 and 2016 at ages 18–24 for men recorded by the HILDA survey (the increase for women was much greater and, left unchanged, would have resulted in what we considered to be an implausible 24% of women aged 18 in the sexual minority population by 2041). We assume that society becomes more accepting of sexual minority individuals and we apply identification-change rates at every age (as shown in Figure 1). The rates were adjusted during the projection horizon via the application of a net identification-change constraint noted above.

We stress that these scenarios are unavoidably speculative and should not be perceived as forecasts. They do, however, allow us to evaluate the impacts of processes affecting identification and to consider plausible demographic futures for the sexual minority population.

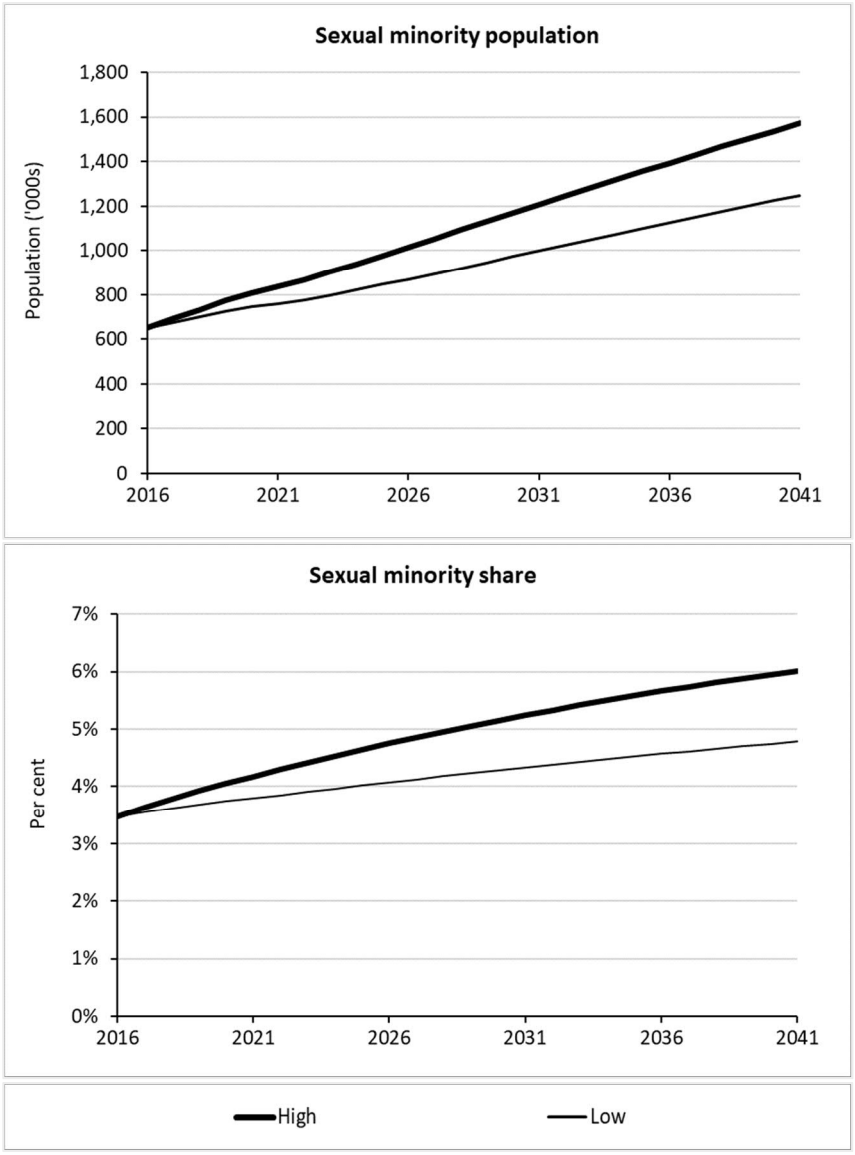
4. Illustrative projections

4.1 Overall population change

Projections of Australia's sexual minority population from 2016 to 2041 are depicted in Figure 2, with population numbers of those aged 18+ shown in the upper graph, and the sexual minority share of the national adult population presented in the lower graph. Under the 'Low' scenario, the sexual minority population of 652,000 in 2016 increases almost linearly to reach 1.25 million by 2041 (an increase of 92%). This growth is due to both national population increase and sexual minority cohort flow – the gradual replacement of cohorts with lower sexual minority identification proportions by those with the higher proportions of young adults in 2016. Under the 'High' scenario, the population grows to 1.57 million by 2041 (141% increase). This higher growth is driven by both rising sexual minority proportions at age 18, generating larger sexual minority cohorts over time, and net identification-change gains. By way of comparison, if the same age–gender proportions of the population identifying as a sexual minority in 2016 applied throughout the projection horizon, the sexual minority population would only grow to 865,000 by 2041 (not shown in Figure 2). This would be due to national population increase alone.

The effects of the scenario projections on the share of the total adult population identifying with a sexual minority identity are shown in the lower graph of Figure 2. Both scenarios project the share of the population identifying with a sexual minority identity rising from 3.5% in 2016 to between 4.8% (Low) and 6.0% (High) by 2041. The decelerating percentage growth shown by the 'High' scenario is due to the gradual reduction in net identification gains assumed as part of this scenario's assumptions.

Figure 2: Scenario projections of Australia's sexual minority adult population (aged 18+) and share of national population, 2016–2041

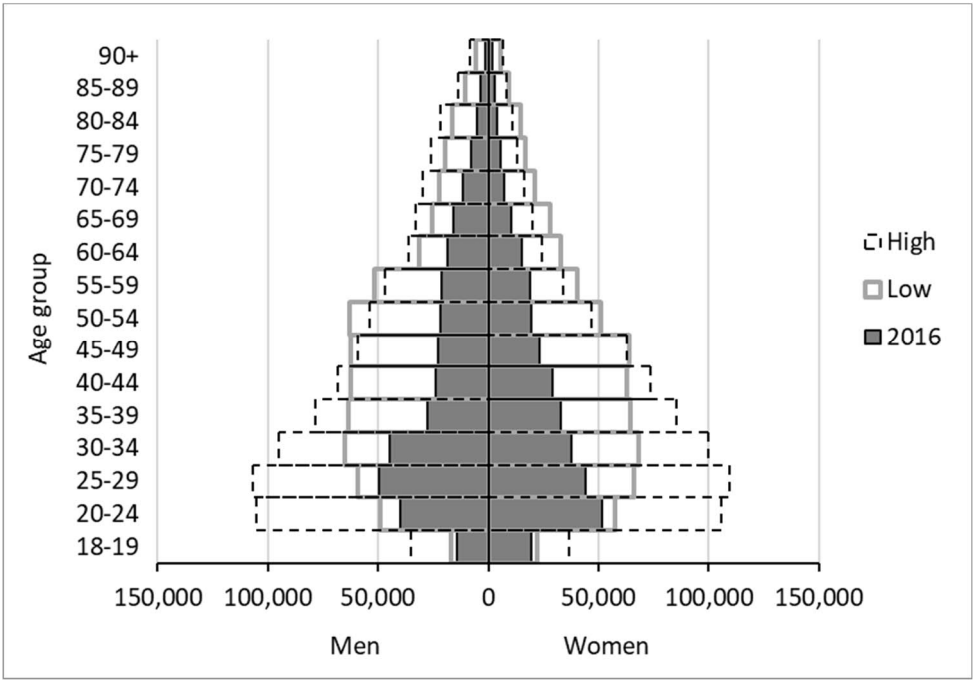


Source: authors' projections

4.2 Population change by age and gender

The two scenarios result in quite different projections of the age and gender structure of the sexual minority population (Figure 3). The initial 2016 sexual minority population is shown by the shaded bars while the outline bars illustrate the projected age–gender structures in 2041 for the two scenarios. In the 'Low' scenario, absolute population growth is highest in the 35–54 age range, but percentage growth is projected to be highest in the oldest age groups. In the 'High' scenario, absolute growth is greatest in the younger adult ages, although percentage growth is still greatest at the oldest ages. However, the pattern of growth by age does vary between the two scenarios due to the different effects of the identification assumptions.

Figure 3: The projected age and gender structure of Australia's sexual minority population in 2041 according to both scenarios



Source: authors' projections.

The impact of identification change in the 'High' scenario results in larger older populations than in the 'Low' scenario for men but not for women. Men at these ages experience net identification-change gains. For women, however, the high rates of sexual-minority-to-heterosexual change at older ages (Figure 1) result in net identification-change losses at these ages.

At younger adult ages, the substantial projected growth in the 'High' scenario relative to the 'Low' scenario is due to net identification-change gains, but also some net losses. For women, there are large net gains from identification-change gains at the start of the projection horizon up to about age 40, after which there are net losses. During the course of the projection horizon, net losses are experienced at progressively younger ages, down to age 27 by the end of the projections. This is the result of the interaction of changing identification rates and a sexual minority population growing faster than the heterosexual population. For men, there are large net identification-change gains at the youngest ages, but net losses from age 25 to 35 at the start of the projections, extending up to age 53 by the end, with net gains experienced at older ages. Again, this is the outcome of the interaction of the age profile of identification-change rates and population size.

The effects of the projection scenarios on sexual minority population shares by gender and broad age group are summarised in Table 2. The 'Low' scenario results in higher proportions than in 2016 across all ages by 2041 as younger cohorts (with the sexual minority proportions of those aged 18–24 in 2016) age over time, replacing older cohorts (with lower proportions). The 'High' scenario is influenced by both increasing cohort identification at age 18 and identification change across all ages, resulting in higher proportions at all ages than in 2016 and higher proportions below age 45 than in the 'Low' scenario and also for men aged 65+.

Table 2: Projected sexual minority shares of population by age and gender, 2016 and 2041

Gender	Women			Men		
Age group	2016	Low scenario 2041	High scenario 2041	2016	Low scenario 2041	High scenario 2041
			Per cent			
18–24	6.3	6.3	11.3	4.6	5.0	10.6
25–34	4.5	6.1	9.5	5.2	5.7	9.1
35–44	3.8	5.7	7.2	3.2	5.8	6.7
45–54	2.7	5.1	4.9	2.8	5.8	5.3
55–64	2.4	4.0	3.2	2.9	4.7	4.7
65+	1.6	2.6	2.1	2.6	3.2	4.3
18+	3.4	4.7	5.6	3.6	4.9	6.4

Source: authors' projections.

5. Discussion and conclusions

In this paper we have introduced an adaptation of the multistate cohort-component projection model for creating projections of the population by sexual identity. We demonstrated the model by presenting 'High' and 'Low' scenarios for the future of Australia's sexual minority population over the next two decades. Both scenarios suggest strong growth in Australia's sexual minority population in future years, and substantially higher growth than in the Australian population as a whole. This will lead to increases in the proportion of the population identifying with a sexual minority identity. If the proportions of young people adopting a sexual minority identity as they reach adulthood continue to increase, there will be very substantial growth in the sexual minority population at young ages over the next few years. As these large cohorts age over time, growth will propagate to older age groups. In addition, if identification change in the adult ages continues to favour the sexual minority population, this process will generate further growth. Even if these age, period, and cohort changes do not eventuate (the 'Low' scenario), the ageing of cohorts at their current sexual minority proportions alone will lead to a near doubling of the sexual minority population over the projection horizon.

Strong projected growth in the sexual minority population will bring potentially substantial social, health, and economic policy implications. As the sexual minority population increases in the future, governments, organisations, and services that invest in and coordinate programmes to support sexual minority populations, such as mental, physical, and sexual health programmes, will need to consider options for scaling-up and expansion, as well as greater outreach in connecting people with services. For example, there are likely to be more same-sex parented families, and support for these families may be needed to assist couples in having and raising children and to prevent experiences of discrimination (Perales et al. 2020). If issues related to stigma and marginalisation continue, further consideration will need to be given to supporting people within educational settings and workplaces and in the care of older people. In Australia the federal government launched an Aged Care Diversity Framework in 2017 (Australian Government Department of Health 2017) to promote inclusivity within services catering to older people. Moreover, the Aged Care Act 1997 enshrines in legislation protection for groups considered to be disadvantaged populations with specific needs, including lesbian, gay, bisexual, transgender, and intersex Australians. Policies and programmes will need sensitive and tailored responses, given the likely rapid growth in the older sexual minority population in coming years.

Several limitations of our projections should be noted. In terms of the projection model design, the greatest approximation lies in the sudden adoption of a sexual identity at age 18, a restriction imposed by data limitations. In the future, more detailed data might enable improvements to be made and allow the modelling of a gradual emergence of

sexual identity over many ages. However, the specification of the model – being based on the multistate cohort-component model – is conceptually strong. The input data, however, is more variable in quality. The 2016 jump-off populations have some degree of approximation, but are based on nationally representative survey data and ABS Estimated Resident Populations. Our fertility assumptions are based on ABS fertility rates so our projected fertility rates should be as robust as those in any national population projection. Our mortality assumptions extrapolate from a long time series of national life tables. While the difference between the mortality of the sexual minority population and the Australian population overall is not known precisely, the mortality assumptions should also be relatively robust given the limited impact of variations in life expectancy on projected populations (see Appendix). Our international migration assumptions are probably less reliable, due to a lack of data on migration by sexual identity. The most uncertain assumptions, however, are those relating to the proportions of cohorts adopting a sexual minority identity as they reach age 18 and identification change over the adult ages. They are based on the most limited data and involve the greatest degree of judgement.

Input data and population projections were also limited to people who reported as either male/man or female/woman. We therefore do not have results for people with genders other than male or female, such as non-binary. With the release of the new ABS standard for sex, gender, variations in sex characteristics, and sexual orientation variables (ABS 2021), it is hoped that future surveys will account for gender in a more comprehensive way, including people who are non-binary, and therefore enable updates to projections reported in this paper.

Apart from signalling potential policy and service provision implications, our study highlights the need for (1) improvements in sexual orientation data availability, (2) a better understanding of sexual identity and identification change over the life course, and (3) when such data are available, extending our model to include additional population categories and more geographical detail. This might include separate estimates and projections for gay/lesbian, bisexual, and other sexual identities, or alternative definitions of the sexual identity population, such as those based on behaviour or attraction. An important step forward in improving the data landscape for sexual minority populations would be to ask a sexual identity question in the census. The census is the ideal data collection instrument for small populations, which are hard to estimate reliably with sample surveys. Indeed, the UK Office for National Statistics and Statistics New Zealand have announced their intention to include a sexual identity question in their next national censuses (Barton 2020; 1 News 2020). This would provide a solid basis for the creation of resident population estimates and migration data. If a sample of anonymised individual records were to be linked between successive censuses (e.g., ABS 2019), identification change could also be measured.

Creating a projection model, and illustrative projections for the sexual minority population of Australia, was undoubtedly an ambitious undertaking, given the data limitations. We have contributed what we hope will prove a useful approach to projecting national populations by sexual identity and understanding the demographic processes experienced by this population. The model could be applied to the populations of other countries with similar data to Australia, such as the United States, the United Kingdom, and New Zealand. The projection scenarios we reported, while illustrative and imprecise, depict plausible demographic futures that can be refined in the future when data availability and quality improve. The projections also contribute to a broader endeavour of highlighting and understanding the evolving diversity of contemporary populations.

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An Excel file of sexual minority population projections for both scenarios is available from the Centre of Excellence in Population Ageing website at https://cepar.edu.au/cepar-population-ageing-projections.

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Appendix

Sensitivity analysis of alternative life-expectancy-at-birth assumptions

Figure A demonstrates the effect of life expectancy at birth assumptions for the sexual minority population that are five years either side of the standard assumptions used in the paper. By 2041, the 'High' scenario projections are 1.61 million (life expectancy 5 years higher), 1.57 million (standard assumption), and 1.53 million (life expectancy 5 years lower). In the 'Low' scenario, the equivalent populations are 1.29 million, 1.25 million, and 1.21 million. The impact of these sizeable life expectancy assumption differences on the projected sexual minority population is quite minor.

Figure A: Projected sexual minority adult population (aged 18+) with alternative life-expectancy-at-birth assumptions