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Ageing of the Aboriginal and Torres Strait Islander population: numerical, structural, timing and spatial aspects

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Abstract

Objectives: To assess levels of numerical, structural, timing and spatial aspects of ageing of the Aboriginal and Torres Strait Islander population.

Methods: Population projections for 15 Australian regions were created by a multi-state cohort-component model.

Results: The older (45-plus) population grew from 29,815 in 1986 to 167,259 in 2016. In the subsequent 30 years, we project growth to 448,785 people. Growth rates of the older population vary: from 200% in the 60–64-year-old group to 800% growth in the 85-plus age group by mid-century. This strong numerical ageing is reflected in a shift in structural ageing by about six percentage points. Selected areas outside of capital cities are structurally older than many cities. Numerical ageing is strongest in capital cities and New South Wales. Cohort flow is the primary driver of ageing.

Conclusions: Numerical and structural ageing is projected to increase significantly to mid-century with important spatial variations. Population ageing is largely irreversible.

Implications for public health: High numerical growth in the older Aboriginal and Torres Strait Islander population poses implications for increased demand for a range of health and care services. Variations in spatial and timing aspects of ageing indicate demand will peak earlier in some geographical locations relative to others.

Key words: Aboriginal and Torres Strait Islander, population projections, population ageing, Indigenous ageing

There is a growing literature on ageing of Aboriginal and Torres Strait Islander people. These studies of *individual ageing* have underscored a heightened prevalence of dementia, disabilities, food insecurity and psychological distress among older Indigenous people, as well as difficulties accessing healthcare and other services, and they highlight the negative effects of exposure to racism and importance of culturally appropriate care in later life.[1-7] Studies have also noted the important social and cultural role that older people play in their families and communities.[8-9] In contrast, there is a dearth of evidence about aspects of *population ageing* in the Aboriginal and Torres Strait Islander population. This diverges from the detailed work by both Government and researchers on population ageing in the broader Australian population.[10-13] Indeed, since 2002 the Australian Government is required to produce an Intergenerational Report (IGR) every five years with detailed population projections. Yet projection by Indigenous status is not considered in any iteration of the IGR.

Although other government reports and sources note Indigenous population ageing, there remains a lack of detailed analysis of the underlying drivers and futures of ageing in the Aboriginal and Torres Strait Islander population.[14,15] The drivers and outcomes of population ageing are important for a number of reasons (e.g. increasing demand for primary and allied health services, formal aged care and informal care provision) and need to be understood through multi-dimensional components of population ageing. Population ageing is often viewed through the lens of structural ageing – measured by the median age of the population or the proportion of the population defined as older, typically aged 65 years and over in national level populations. However, population ageing represents several related but distinct aspects of population change, including structural, but also numerical (absolute size of the older population) components of change. For both numerical and structural ageing, one may consider two temporal components: the timing and spatial distribution of both numerical and structural ageing across Australia's cities and regions. The underlying demographic processes as well as social and economic implications (for governments, corporations and families) may also differ across these measures. For example, although the Aboriginal and Torres Strait

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Islander population is relatively young, the size of the older population is likely to grow rapidly due to: a) growth in the population generally (numerical) including that due to identification change and cohort flow; and b) a shift in the age composition of the population including that due to increasing life expectancy and low fertility (structural). Further, the growth in the older population may be unevenly distributed across Australia with particular implications for health demand in regional and remote areas, as well as high-growth urban areas.

For the Australian population overall, with high-quality time series measures of the underlying demography (estimated resident population, mortality, fertility and international migration (and to a lesser extent internal migration), understanding population ageing and its drivers is a relatively straightforward task. However, for the Aboriginal and Torres Strait Islander population, complexity arises due to data quality concerns[16] (and levels of spatial aggregation as a result), measurement of the Indigenous status of mothers and children and changing identification of indigeneity over time (which recently has been substantial[17]). In this paper, we outline a new multi-state cohort-component projection model to project the Australian population by Indigenous status over the period 2016 to 2051, with a view to: 1) understanding current and projected levels of numerical and structural ageing; 2) the determinants of ageing; and 3) how ageing and its determinants vary spatially and over time. Following analyses of these three research questions, we conclude with a description of potential implications for public health in Australia.

Data and methods

To understand future ageing in the Aboriginal and Torres Strait Islander population, population projections by Indigenous status were prepared for 15 large regions of Australia by sex and five-year age groups for the period 2016–51. Building on earlier work by Raymer et al[18], Biddle[19] and Wilson,[20] a multi-state cohort-component model was created that incorporates all the demographic components influencing population change: births, deaths, migration, people reporting their Indigeneity differently from one census to the next (identification change), and women giving birth to babies with a different Indigenous identity to themselves due to Indigenous/non-Indigenous partnering (intergenerational ethnic mobility). The new projection model employs a movement accounts framework[21] and is an extension to the whole of Australia of an earlier model designed for the Northern Territory.[20] Mathematical details of the projection model are available in a separate paper.[22] The projection model differs notably from that of the Australian Bureau of Statistics (ABS) by: 1) including identification change; 2) providing the simultaneous modelling of the Aboriginal and Torres Strait Islander population and non-Indigenous population; and 3) producing projections for the capital cities and rest of state/territory regions that form the Greater Capital City Statistical Area (GCCSA) geography.[23]

The initial 2016 populations consisted of Indigenous Estimated Resident Populations (ERPs) prepared by the ABS.[24] The preparation of data inputs and formulation of projection assumptions required considerable amounts of indirect data estimation and reconciliation. A custom table of births by Indigenous status of women for the 2011–16 period was purchased from the ABS and age-specific fertility rates were calculated using female populations-at-risk in the denominators. Age-specific rates were summed to calculate Total Fertility Rates (TFRs). TFRs for Indigenous women were adjusted upwards to achieve consistency with the number of 0–4-year-old Aboriginal and Torres Strait Islander infants in 2016. They were assumed to decline gradually throughout the projection horizon subject to a lower limit of the non-Indigenous TFR. TFRs of non-Indigenous women were held constant from 2011–16 values. Intergenerational ethnic mobility assumptions were prepared as the proportion of babies born to Aboriginal and Torres Strait Islander and non-Indigenous mothers who are Indigenous, with data derived from a customised 2016 Census table cross-classifying mothers' and 0–4-year-olds' Indigenous status within households. In the projections, this means that a baby can be Aboriginal or Torres Strait Islander even where the mother is non-Indigenous because the father is Aboriginal or Torres Strait Islander.

Mortality assumptions were created in terms of life expectancy at birth. Projections of national age-specific death rates by Indigenous status were prepared using Ediev's extrapolative approach, and life tables, including life expectancy at birth, were derived from these projections.[25] Life expectancy for 2011–16 was estimated by region, sex and Indigenous status based on recent ABS life expectancy values for Indigenous populations by remoteness area and GCCSA life expectancy values that were used for the non-Indigenous population.[26,27] Differences between national life expectancy by sex in 2011–16 and equivalent values by region were assumed to remain fixed throughout the projection horizon. Thus, each region's life expectancy projections increased in parallel with those at the national level. This conservative approach was taken given the limited data on long-run subnational Indigenous mortality trends; the exception is the Northern Territory, where Indigenous and national Australian life expectancies have moved roughly in parallel for the past 50 years.[28] Age-specific death rates for the regions were obtained from the national projections at points where each region's life expectancy assumptions matched the national age-specific death rates. The national projections thus act as a 'mortality surface' of model life tables and age-specific death rates.[29]

Internal migration data for the 2011–16 period by region, sex, age and Indigenous status were estimated from ABS Regional Internal Migration Estimates (RIME) and 2016 Census migration data. Identification change estimates for 2011–16 were extracted from the 5% sample of linked 2011 and 2016 census records in the Australian Census Longitudinal Dataset (ACLD). Both sets of estimates are subject to uncertainty and error, the migration data because they had to be estimated indirectly, and the identification change estimates because they are based on a sample with known limitations.[30] These two data inputs were then reconciled in a population accounting table using iterative proportional fitting so that all the demographic components of change over the 2011–16 period matched total population change as measured by the difference between 2016 and 2011 ERPs by Indigenous status. Directional migration and identification change rates by age, sex and Indigenous status were then calculated using ERPs by Indigenous status in the denominators and smoothed over age using de Beer's TOPALS method.[31] Both sets of age-specific rates were constrained over the course of the projection horizon to give constant net migration totals (summed over age and sex) and net identification change totals (summed over age and sex). This avoids implausible net migration and

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net identification flows in the long run when age-specific rates are held constant.[32] For overseas migration, both immigration and emigration for the Indigenous population were set to zero. Census immigration data reveal overseas migration among Aboriginal and Torres Strait Islander people is very small and can be reliably ignored.

To understand why population ageing is projected to occur in the Aboriginal and Torres Strait Islander population we undertook a decomposition. This revealed the extent to which each of the demographic factors – life expectancy increases, net identification change, mother-baby ethnic mobility, internal migration, non-replacement fertility, and cohort flow – will be responsible for future ageing. We followed the approach of Bongaarts and Bulatao (1999) by creating a series of variant projections in which the demographic factors are successively removed to reveal the influence of each one.[33] This same approach was applied by Rees et al. (2013) to understand projections of subnational ethnic group populations in the UK, and by Andreev et al. (2013) to provide insights into United Nations Population Division projections.[34,35]

We selected age 45 as the threshold age of the older Aboriginal and Torres Strait Islander population. As noted earlier, the median age of the population or percentage of the population aged 65 and over is often used as a proxy measure of structural ageing. However, as widely acknowledged in the *individual ageing* literature, there are numerous reasons to utilise a lower age limit of 45 or 50 for the Aboriginal and Torres Strait Islander population.[1,6,7,36,37] First, there is a considerable gap in life expectancy of about one decade between Aboriginal and Torres Strait Islander and non-Indigenous Australians, reducing the proportion of the population living into advanced old age.[38,39] Second, many conditions and comorbidities, as well as frailties commonly associated with ageing, are early onset in this population.[1,2,40] Third, in recognition of the above two points, government programs such as those governing access to specific aged care services are available to Aboriginal and Torres Strait Islanders from age 50 when compared to non-Indigenous Australians. Apart from these empirical and policy reasons, we find the correlation between structural ageing (as defined by the percentage of the population 45-plus) and the median age of the population to be very high (r=0.97). This is consistent with Murphy's (2017) observation of a high degree of correlation between alternative measures of population ageing.[41]

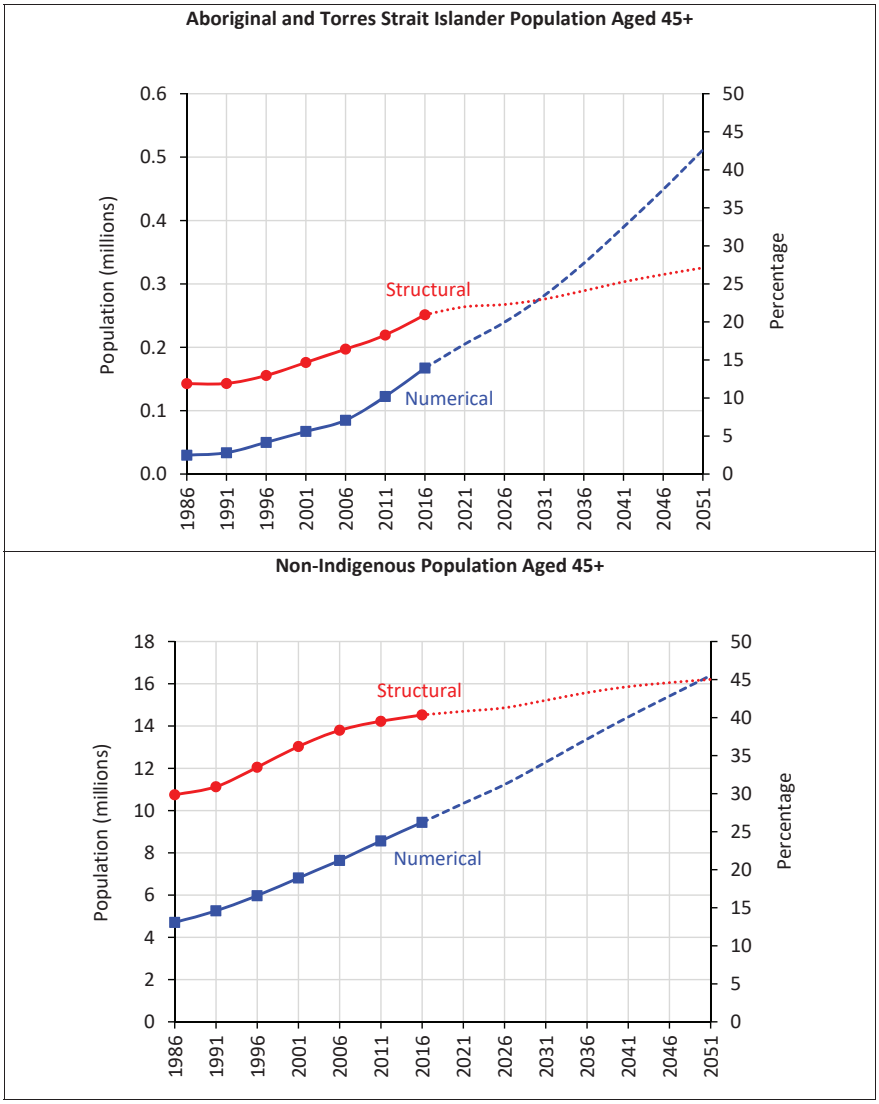
The ABS has the authority to provide the input data used in our modelling under the *Census and Statistics Act 1905*. Ethics approval for this project was granted by the Melbourne School of Population and Global Health Human Ethics Advisory Group (HEAG) – Ethics ID: 1955637. Detailed Aboriginal and Torres Strait Islander population projections by age, sex and region, including estimates of numerical and structural ageing, are available as a supplementary file to this paper (Supplementary Table 1), in addition to results from the detailed sensitivity analyses (Supplementary Figure 1).

Results

National level – numerical and structural ageing

Figure 1 displays the historical (1986–2016) and projected (2016–2051) levels of numerical and structural ageing in the Australian population, disaggregated by Indigenous status. From 1986 to 2016, the older Aboriginal and Torres Strait Islander population (45-plus) grew from 29,815 to 167,259, representing an increment of approximately 137,000 people. Over the subsequent 30 years (2016 to 2046) we project an increase of approximately 280,000 persons in the older population to 448,785 in 2046. Despite this strong growth in numerical ageing, growth in structural

Figure 1: Numerical and Structural ageing in the Aboriginal and Torres Strait Islander population and non-Indigenous population, Australia, 1986 – 2051.



Notes:

Structural- structural ageing defied as population aged 45+ as a percentage of the population; Numerical – numerical ageing defined as population aged 45+. Dashed lines – projected structural and numerical ageing. Solid lines – calculated from ABS estimated resident population counts.

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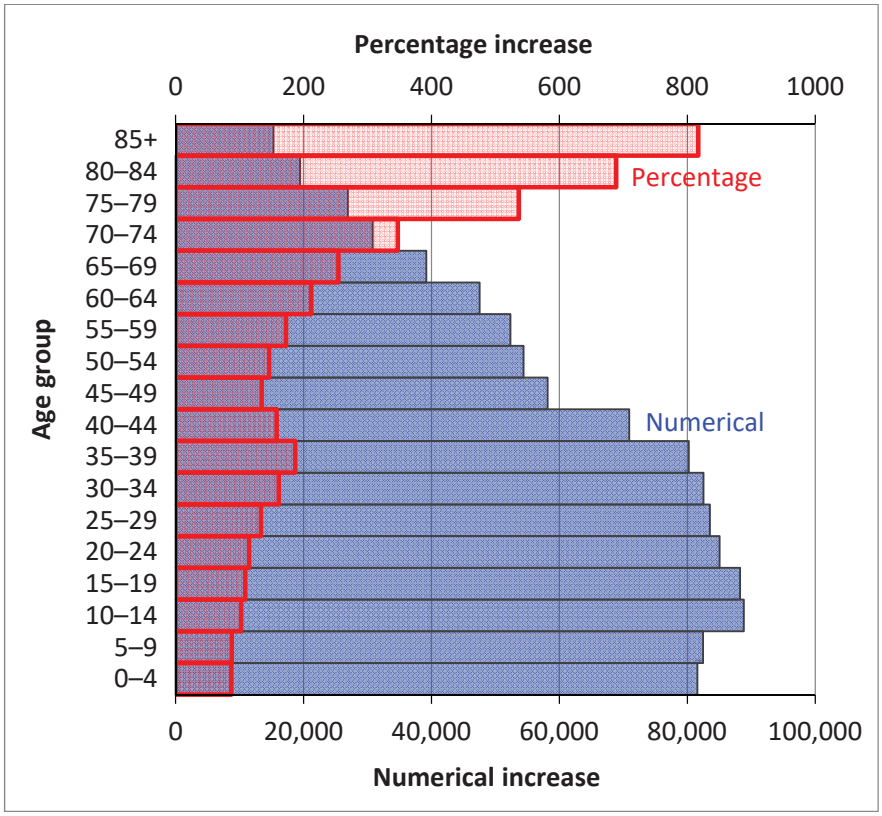
ageing is projected to be more subdued. Between 1986 and 2016, the percentage of the population aged 45 and over grew from 12% to 21% – a change in the age distribution by about nine percentage points. By 2046, we project about 26% of the population to be aged over 45 – representing a change in the age distribution by about five percentage points over this 30-year period. The non-Indigenous population is considerably older in structural terms. In the non-Indigenous population, the proportion aged 45 and over rises from 30% in 1986 to 40.4% in 2016 and 44.6% in 2046. So, although structurally older, the projected relative speed of change in the age structure is consistent between the Indigenous and non-Indigenous population (i.e. approximately a five to six percentage point shift in age structure).

Our projections also indicate considerable shifts within the age structure over the projection horizon (Figure 2). Between 2016 and 2051, the majority of the numerical growth in the Aboriginal and Torres Strait Islander population is aged under 45 years. Nonetheless, as indicated above, projected numerical ageing is considerable. Although from a relatively small base, the numerical growth from age 60–64 years age rises from a 200% increase to 800% growth in the 85-and-over population between 2016 and 2051.

Subnational level – numerical and structural ageing

These changes at the national level may not represent the levels of ageing at the subnational level due to differences in the underlying age structures and components of demographic change in operation. Table 1 displays indicators of numerical (N) and structural ageing (%) alongside the distribution of the older Aboriginal and Torres Strait Islander population across 15 regions (Dist). This table also displays for the full projection period 2016 to 2051, the difference in numerical and structural ageing, the change in geographic distribution of the older Aboriginal and Torres Strait Islander population and the ratio of the population over this period. As a measure of the speed of structural ageing, the year in which each subnational population reached the structural age of Australia's population in 2051 (37% aged 45-plus) is noted.

Figure 2: Numerical and Percentage Increase in the Aboriginal and Torres Strait Islander population, by Age, Australia, 2016–2051.



Notes:
Numerical increase – population at each age in 2051 minus population in 2016; Percentage increase – ((Population 2051/Population 1986)-1)X100.

In 2016, 61% of the older population resided in New South Wales (NSW) or Queensland (QLD). Over the projection period, this rises to just under 65% of the older Aboriginal and Torres Strait Islander population, and areas outside of capital cities in these states comprise 46% of the older population in 2051. Specifically, of the total increment to the older population (344,093 from 2016 to 2051), an additional 106,476 Aboriginal and Torres Strait Islander people are projected to live in Rest NSW and 57,015 in Rest QLD. Growth rates (as measured by the ratio of the population in 2051 to 2016) in numerical ageing are strongest in Rest NSW (3.7), Sydney (3.5), Brisbane (3.4), Darwin (3.1) and Hobart (3.1), Melbourne (3.0) and Perth (3.0) – all with three-fold growth in the older population.

In 2016, the levels of structural ageing are highest in Rest Tas (Tasmania), being 24.9% aged 45-plus), Rest SA (South Australia) at 22.8 and Rest NSW (22.2) and lowest in Perth (18.2), Brisbane (18.5) and Adelaide (18.7). By 2051, structural ageing is projected to be strongest in Rest NT (Northern Territory), being 36.5, Rest SA (33.7) and Rest Tasmania (32.6) with cities again dominating with lower levels of structural ageing: Perth (21.4), Melbourne (21.8) and Brisbane (22.9).

The speed of structural ageing (as measured by the shift in structural ageing over the period) and timing (as measured by the year a population reaches the Australian Indigenous average in 2051 = 27%), are amplified in Rest NT (e.g. reaches the Australian 2051 age between 2026 and 2031), Rest SA (2026–2031), Rest Tas (2026–2031), Rest WA (Western Australia) 2031–2036, Hobart (2036–2041) and Rest NSW (2036–41).

Determinants of numerical and structural ageing

Spatial variations in the levels and timing of structural and numerical ageing raise the issue of differing determinants of ageing (Figure 3). At the national level, for numerical ageing, approximately 59% of the change in the number of Aboriginal and Torres Strait Islander people aged 45 and over is driven by population momentum or cohort flow; that is, ageing of the existing cohort. A further 30% of the change in numerical ageing is attributable to identification change and just 12% to forecast increases to life expectancy from 2016 to 2051.

For structural ageing, we decompose the factors driving the difference in structural ageing between 2016 and 2051. As noted

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earlier, in 2016, 20.9% of the Aboriginal and Torres Strait Islander population is aged 45 and over compared with 27.1% in 2051. Of this difference over the projection period (6.2%), factors can both contribute and detract from the change in the level of structural ageing. Population momentum (or cohort flow) accounts for the majority of increase in ageing over the projection period (12.4%), followed by life expectancy (2.0%) and a minor positive effect of changing spatial composition due to internal migration (0.2%). Working from the opposite direction, mother–baby ethnic mobility (-5.6%), identification change (-1.8%) and non-replacement fertility (-1.0%) have a rejuvenating effect on the population age structure. All these factors sum to 6.2% – the change in structural ageing over the period.

The relative roles of these components differ to some degree at the subnational level (Figure 4). Of note, across Sydney, Melbourne, Brisbane, Adelaide, Perth and the Australian Capital Territory (ACT), migration reduces both structural and numerical ageing. For numerical ageing, this arises due to the out-migration of older Aboriginal and Torres Strait Islander people, and for structural ageing, a combination of both older age out-migration and younger age inward migration. Nonetheless, across all sub-populations, cohort flow accounts for the majority of change in both numerical and structural ageing.

Sensitivity of numerical and structural ageing to changing demographic and non-demographic assumptions

The differing determinants of ageing raise the question of the sensitivity of our results to the underlying demographic and non-demographic projections assumptions.

Supplementary Figure 1 displays levels of numerical and structural ageing for years 2021 to 2051 at 10-yearly intervals, by variations in net identification gain, life expectancy increase, and variations in the fertility (TFR). The dashed line in each graph represents the assumption used in our modelling.

Over the medium projection horizon (to 2031), variations in identification change, life expectancy change of fertility change have little impact on levels of numerical ageing, although variations in fertility have some impact on structural ageing. In the longer term, 2036–2051, net identification change has a strong impact on numerical ageing but effects of variations in life expectancy change are less so, and no impacts of fertility change. Over this period, higher fertility plays a strong role in moderating structural ageing, with increases in life expectancy having the opposite effect. Net identification change in

Table 1: Indicators of structural and numerical ageing, Aboriginal and Torres Strait Islander population, by region, 2016–2051.

	2016			2051			2051 - 2016			Ratio	Year Austr.
	N	%	Dist	N	%	Dist	N	%	Dist	Pop.	Str = 27%
Sydney	18,167	20.9	10.9	63,444	24.2	12.4	45,277	3.3	1.5	3.5	n.a.
Rest NSW	39,642	22.2	23.7	146,118	29.6	28.6	106,476	7.5	4.9	3.7	2036-2041
Melbourne	6,120	20.7	3.7	18,527	21.8	3.6	12,407	1.1	0.0	3.0	n.a.
Rest Vic	6,041	21.4	3.6	16,721	27.8	3.3	10,680	6.4	-0.3	2.8	2046-2051
Brisbane	11,992	18.5	7.2	41,139	22.9	8.0	29,147	4.4	0.9	3.4	n.a.
Rest Qld	32,004	20.5	19.1	89,016	27.0	17.4	57,012	6.5	-1.7	2.8	2051
Adelaide	4,268	18.7	2.6	11,677	23.1	2.3	7,409	4.4	-0.3	2.7	n.a.
Rest SA	4,436	22.8	2.7	10,084	33.7	2.0	5,648	11.0	-0.7	2.3	2026-2031
Perth	7,579	18.2	4.5	22,430	21.4	4.4	14,851	3.2	-0.1	3.0	n.a.
Rest WA	12,877	21.9	7.7	31,303	32.5	6.1	18,426	10.6	-1.6	2.4	2031-2036
Hobart	2,239	21.7	1.3	6,936	29.0	1.4	4,697	7.3	0.0	3.1	2036-2041
Rest Tas	4,543	24.9	2.7	11,877	32.6	2.3	7,334	7.7	-0.4	2.6	2031
Darwin	3,768	21.6	2.3	11,848	27.9	2.3	8,080	6.3	0.1	3.1	2046
Rest NT	12,045	21.1	7.2	25,986	36.5	5.1	13,941	15.4	-2.1	2.2	2026-2031
ACT	1,449	19.3	0.9	4,157	20.6	0.8	2,708	1.3	-0.1	2.9	n.a.
Australia	167,170	20.9	100	511,263	27.1	100	344,093	6.2	0.0	3.1	2051
Region Rank											
Sydney	3	9	3	3	10	3	3	12	2	2	n.a.
Rest NSW	1	3	1	1	5	1	1	5	1	1	5
Melbourne	8	10	8	8	13	8	8	15	6	6	n.a.
Rest Vic	9	7	9	9	8	9	9	8	10	10	8
Brisbane	6	14	6	4	12	4	4	11	3	3	n.a.
Rest Qld	2	11	2	2	9	2	2	7	14	9	n.a.
Adelaide	12	13	12	12	11	12	11	10	9	11	n.a.
Rest SA	11	2	11	13	2	13	13	2	12	14	1
Perth	7	15	7	7	14	7	6	13	8	7	n.a.
Rest WA	4	4	4	5	4	5	5	3	13	13	4
Hobart	14	5	14	14	6	14	14	6	5	5	5
Rest Tas	10	1	10	10	3	10	12	4	11	12	3
Darwin	13	6	13	11	7	11	10	9	4	4	7
Rest NT	5	8	5	6	1	6	7	1	15	15	1
ACT	15	12	15	15	15	15	15	14	7	8	n.a.

Notes:

N number aged 45+; % percentage of population aged 45+; Dist geographic distribution of population; Ratio pop. Ratio of population in 2051 to 2016; Year Austr. Str = 27% The year in which each population is projected to reach the structural age of Australia projected in 2051.

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the longer term has a relatively minor impact on structural ageing.

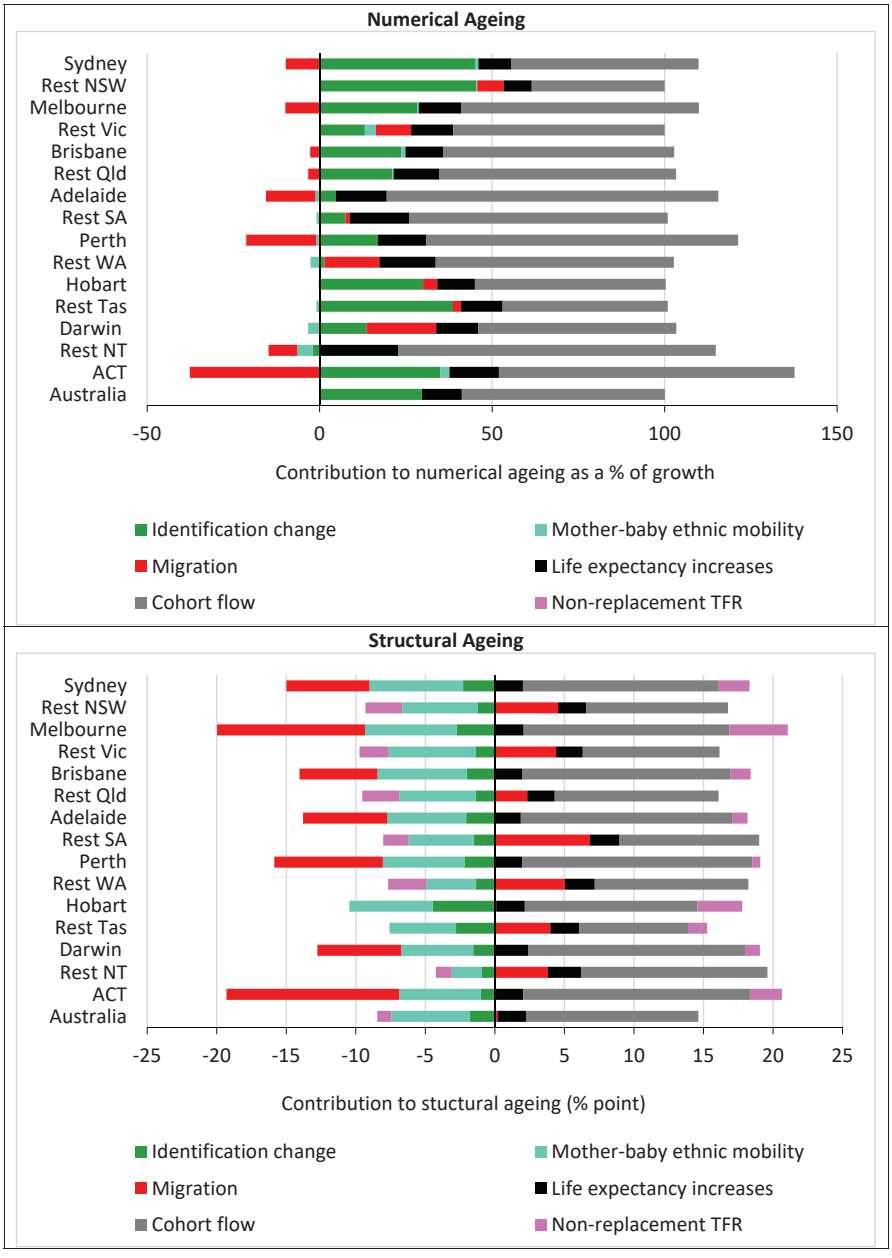
Discussion

Heretofore, there has been limited analyses of the ageing of the Aboriginal and Torres Strait Islander population. Our new results uncover very strong numerical ageing in the Aboriginal population, with growth rates particularly high at older ages (in excess of 800% growth in the 85-plus age group by mid-century). Numerical ageing is shown to be spatially heterogeneous with growth particularly strong (with a minimum three-fold increase) in Rest NSW (3.7), Sydney (3.5), Brisbane (3.4), Darwin (3.1), Hobart (3.1), Melbourne (3.0) and Perth (3.0). Our estimates indicate that now (61%) and in the future (66%) the majority of the older Aboriginal and Torres Strait Islander population will be residing in either NSW or QLD.

Our findings of rapid numerical ageing of the Aboriginal and Torres Strait Islander population underscore the additional demands that will be placed on the healthcare system to address the needs of this growing population. Among other stakeholders, the Australian and New Zealand Society for Geriatric Medicine argue that lack of access to primary and specialist medical services already reduces the opportunity for prevention and early intervention, acting as a barrier to healthy ageing among Aboriginal people.[42] Combined with rapid numerical ageing, this will result in increased demand for aged care programs in Australia: for those providing care in the community (Commonwealth Home Support Programme [CHSP] and Home Care Packages Programs), in care (Residential Aged Care [RAC]) or its alternatives (Flexible Aged Care, Aboriginal and Torres Strait Islander Flexible Aged Care).[43] However, a recent Australian Government audit acknowledged that: 1) there are barriers specific to accessing aged care services that disproportionately impact older Aboriginal and Torres Strait Islander Australians; 2) that current service models do not always have the time to build up trust; and 3) that Aboriginal and Torres Strait Islander service providers are often not aware of the packages available.[44] Moreover, in contrast to the rest of the Australian population, the growth of the uptake of homecare packages among Aboriginal and Torres Strait Islander people was at the higher needs level rather than at the basic/minimum needs level, suggesting that until the need for services is unavoidable, Aboriginal people may not be being offered and/or seeking homecare packages.[44] Failure to receive homecare may lead to a higher level of dependence in the future – placing additional stress on a stretched healthcare system. Addressing these policy and program deficiencies is critical given the significant increase in future demand on the Australian aged care system implied by our projections. The future demand for aged care and other health services is further complicated by the significant spatial heterogeneity in numerical ageing that our projections identify, in addition to differing needs for healthcare services across states and territories.[45]

In addition to identifying strong numerical ageing, we also show that although the level of structural ageing is lower in the Aboriginal and Torres Strait Islander population relative to the non-Indigenous population now and in the long-term, the speed of population ageing (as measured by the shift in the population age structure) is similar between populations – approximately a 6% point change in the percentage of the population aged 45-plus by mid-century. As with numerical ageing, we find considerable spatial heterogeneity in structural ageing: the

Figure 3: Contribution to numerical and structural ageing in the Aboriginal and Torres Strait Islander population, Regions, 2016–2051.



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speed of structural ageing above the national average in non-capital city regions in the Northern Territory, Tasmania, South Australia, Western Australia and New South Wales.

Apart from increasing demand for health services due to numerical ageing, structural ageing brings unique challenges as well as opportunities. One key policy implication of increased numerical ageing is an increased demand for the provision of health and care services that is not only culturally appropriate but is also delivered by Aboriginal and Torres Strait Islander people.[3] This increased demand comes at the same time a recent study of the Aboriginal and Torres Strait Islander health workers from 2006 to 2016 shows "growth that is incommensurate with population increases, a stagnant proportion of male Indigenous Health Workers and an ageing workforce".[46] Research in the broader Australian population has shown that structural ageing plays an important role in dampening both labour supply growth and GDP per capita.[10,11,47,48]

As the speed of population ageing is roughly comparable between the Aboriginal and Torres Strait Islander and non-Indigenous populations, this raises the issue of the supply of Indigenous workers to fulfil this increased demand due to numerical ageing. As argued by Davy et al. in their detailed systematic review of care for older Aboriginal and Torres Strait Islanders, "having the support of culturally safe primary health-care and aged-care services that understand the importance of maintaining an Indigenous identity and promoting independence will be crucial for the well-being of older Indigenous peoples".[5] A significant barrier to achieving these aims is the considerable underrepresentation of Aboriginal and Torres Strait Islander people in aged care, health and allied services – including at the policy development and decision-making level.[3] Structural ageing, *ceteris paribus*, could further hamper the supply of Indigenous health workers. Nonetheless, more detailed analysis is required of labour supply futures for the Aboriginal and Torres Strait Islander population with an emphasis not only on demographic drivers of supply but also structural factors at play (e.g. trends in labour force participation, unemployment rates and their underlying determinants, for example, racism in the workplace or job search).[47,48,49]

Finally, at both the national and subnational level, the strong role of cohort flow as a determinant of ageing underscores that population ageing in the Aboriginal and Torres Strait Islander population is unavoidable and largely irreversible. Any reasonable shifts in our underlying assumptions regarding net identification, life expectancy or fertility have only minor impact upon numerical or structural ageing in the short to medium term of our projection horizon. Thus, although numbers may shift, the underlying results (levels and drivers of ageing across regions) will remain similar. This indicates that the 'solutions' to population ageing do not rest with demographic levers, but rather with reform to social and economic policy aimed at improving the ageing experience of Aboriginal and Torres Strait Islander people.

Numerical and structural ageing of the Aboriginal and Torres Strait Islander population also brings with it advantages and opportunities for the future. Traditional Indigenous societies have been organised by language group, and within this, local groups (clans, mobs) and family.[50] Thus, Aboriginal and Torres Strait Islander families are extended through a kinship system and do not align with the nuclear family more prevalent in the mainstream Australian population. Numerical and structural ageing of the Aboriginal and Torres Strait Islander population will increase the extent to which older people are represented in kinship groups and will bring the advantages of life experience, but also kinship responsibilities to care for ageing relatives. Health and social policy will need to be directed towards understanding ageing in the context of Aboriginal and Torres Strait Islander kinship systems and provide responsive care that responds to the family context of older Aboriginal people. Older Aboriginal and Torres Strait Islander people live with a higher burden of chronic disease and frailty with a higher prevalence of conditions including diabetes, cardiovascular disease, dementia and musculoskeletal disorders. Primary healthcare, aged care and community supports including housing and respite care will need to respond to the unique circumstances of Aboriginal and Torres Strait Islander families.

Limitations

In interpreting results from our study, it is important to note the limitations of our input data and methodology. Demographic data by Indigenous status, unfortunately, suffer from greater quality and coverage limitations than that for the Australian population as a whole. Indigenous ERPs for 2016 are unlikely to be perfect. Indigenous fertility estimates are likely under-estimates (and were adjusted upwards in this study); life expectancy had to be estimated indirectly from the available ABS data. Identification change flows were derived from a sample of census records created using probabilistic data linkage. There are no annual migration data with an Indigenous identifier, so migration data needed for the projections had to be indirectly estimated. Reconciliation of the 2011–16 population accounts resulted in non-trivial adjustments to migration and identification change flows. The formulation of projection assumptions was hampered by the lack of reliable time series for all demographic datasets, a problem that is greater at the subnational scale. We therefore took a conservative approach and held many headline assumptions constant into the future. Although it would be possible to argue for a range of alternative assumptions, we believe our results reflect a plausible and reasonable set of projections in the context of the current data environment and recent demographic trends as far as they can be determined.

Conclusion

Noting these limitations, our study is the first to provide a detailed analysis of numerical and structural ageing of the Aboriginal and Torres Strait Islander population from both a timing and spatial-temporal lens. Our results underscore: 1) strong numerical ageing with growth rates particularly high in older age groups; 2) structural ageing that, while lower than that of the non-Indigenous population, occurs at a similar speed; 3) considerable spatial heterogeneity in the above processes; and 4) both numerical and structural ageing being primarily driven by cohort flow or population momentum and thus being irreversible. Our results pose implications for increased demand for a range of health and care services, with timing of demand peaking earlier in some geographical locations relative to others.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary Figure 1: Sensitivity analyses, Net Identification Change, Life Expectancy and Fertility, National Level, Selected years from 2021 – 2051.

Supplementary Table 1: Aboriginal and Torres Strait Islander Population Projections, by Region.

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