Life Expectancy and Healthy Life Expectancy of Migrant and Native-born Population in Australia, 2006–2016

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Abstract

How health status changes over time as migrants become integrated and acculturated into their host country has not been adequately understood in the literature. This study contributes to the research of migrants' health and wellbeing by providing the first comprehensive examination of migrants' life expectancy (LE) and healthy life expectancy (HLE) and their age variations in the context of Australia, 2006-2016. Results show that compared with the Australia-born population, the overseas-born population enjoys longer LE at all ages; however, the overseas-born population suffer lower HLE in later life and lower ratio of HLE/LE throughout all ages. Additionally, HLE and the ratio of HLE/LE of the overseas-born population decline at a greater pace than they do in the Australia-born population as age increases, particularly between age 25 to age 84, while at very old age, the decline of migrants' health status proceeds more slowly than the health status of the Australia-born population. The decline in migrants' HLE and the ratio of HLE/LE are more prominent among female migrants than do male migrants. Results also indicate that the overseas-born population enjoyed prolonged LE during the period 2006–2016, whereas their HLE stagnated and their ratio of HLE/LE decreased over the same period, suggesting a declining quality of life for migrant population in Australia. Results imply different patterns of the 'healthy migrant effect' in mortality and morbidity as well as significant age variations in the effects of acculturation on migrants' health outcomes. The policy implications of these findings are discussed, including adopting life-course approaches to improve migrants' health outcomes and quality of life.

Keywords: healthy life expectancy, quality of life, migrants' wellbeing and health, the 'healthy migrant effect', nativity differences

1. Introduction

International migration, largely powered by ongoing globalisation and international socioeconomic inequality (Castles, 2013; Czaika and De Haas, 2014), has profoundly transformed the demographic profiles of major migrant-receiving societies. Countries with a large number of international migrants, such as the United Kingdom (UK), the United States (US), Australia and Canada, have all experienced remarkable growth in the size of their international migrant population over the past several decades (United Nations, 2019). This significant increase in the migrant population, both in number and proportion, has made important social, cultural and economic contributions to the migrants' countries of destination. It also has profound implications for the health care system and health policy of migrant-receiving societies and has raised growing concerns about migrants' wellbeing and health from both policymakers and scholars (Van der Stuyft et al., 1989; Khoo, 2010; Gimeno-Feliu et al., 2015).

One of the most concerning issues associated with migrants' wellbeing and health is how migrants' health outcomes change as they become integrated and acculturated into the host society. Existing studies suggest that migrants' wellbeing and health exhibit different patterns at different times over the course of the acculturation process (Berry, 2005; Biddle et al., 2007; Cunningham et al., 2008; Anikeeva et al., 2010; Peiro and Benedict, 2010; Khoo, 2012; Vang et al., 2017). Specifically, in many countries, international migrants as a whole are on average healthier than the local population, particularly when they first arrive in the host country (Jass and Massey, 2004; McDonald and Kennedy, 2004). This health advantage, known as the 'healthy migrant effect', is particularly prominent in relation to mortality (Anikeeva et al., 2010; Ruiz et al., 2013; Vang et al., 2017), and more significant among male migrants and those migrating when middle aged (Trovato and Odynak, 2011; Garcia and Chiu, 2016). However, with longer duration of residence, migrants' health advantage tends to decrease over time and some migrant communities even come to suffer worse health outcomes at old age than the native-born population (McDonald and Kennedy, 2004; Biddle et al., 2007). This paradoxical phenomenon has been reported in many major migrant-receiving societies around the world (Sundquist and Johansson, 1997; Salant and Lauderdale, 2003; McDonald and Kennedy, 2004; Page et al., 2007; Anikeeva et al., 2010; Kennedy et al., 2015). However, how migrant health status changes over time as migrants age and acculturate into the host society is still not well understood.

Healthy life expectancy (HLE) is a well-established indicator of public health outcomes, and is defined as the average years of expected healthy or specific-disease-free time remaining in a person's life at a certain age, thus reflecting both length and quality of life (Jagger and Robine, 2011). Recent years have witnessed a proliferation of research using HLE as a new indicator to explore migrants' wellbeing and health (Eschbach et al., 2007; Garcia and Chiu, 2016; Garcia et al., 2017; Reus-Pons et al., 2017; Garcia et al., 2018; Garcia

et al., 2019). Results of such research indicate that migrants, particularly older migrants, have a significantly longer life expectancy (LE) than the native-born population but a similar or even lower HLE. This implies that the healthy migrant effect does not apply to morbidity in migrants at old age.

However, our current understanding of migrants' HLE is inadequate. Existing research on migrants' HLE has been without exception in the US or Western European context. The experiences of other major migrant-receiving societies, which have distinctly different migration profiles from those of the US and Western European countries, have not been explored. In addition, the majority of research on migrants' HLE focuses on older migrants rather than all age groups of migrants, thus overlooking age variations in migrants' HLE. This limits our understanding of the changes in migrants' HLE over the entire life course of the population.

To fill these research gaps, the present study presents a comprehensive examination of migrants' LE and HLE in the context of Australia, a major migrant-receiving country. The study uses nationally representative data to compute and compare LE and HLE of the Australia- and overseas-born populations over a period of one decade from 2006 to 2016. The study provides estimates of HLE of Australia-born and migrants for the first time and analyses the nativity differences in HLE, specifically by age, gender and year. The research provides new understanding of how migrants' wellbeing and health change over the life course of a hypothetical cohort, as well as new insights into the different manifestations of the healthy migrant effect in mortality and morbidity, shedding light on this matter to inform future policy formulation to enhance health care policy in Australia and elsewhere.

2. Literature Review

2.1 Paradox of Migrant Health

The phenomenon of the healthy migrant effect, initially dubbed the 'Hispanic health paradox', was first reported in the US, where Hispanic Americans in several southwestern states of the US were found to have similar or even better outcomes in mortality and LE than the US-born population, despite their lower socioeconomic status (Teller and Clyburn, 1974; Bradshaw and Fonner Jr, 1978; Schoen and Nelson, 1981). Research later reported that this mortality advantage over the US-born population not only existed among Hispanic Americans but also in many other migrant communities in the US (such as those from China, South Korea and Germany) (Cunningham et al., 2008). Similar evidence of lower mortality among migrants than the native-born population has been reported in many other migrant-receiving countries, for example, the UK (Kennedy et al., 2015), Canada (Kennedy et al., 2015), Australia (Salant and Lauderdale, 2003), New Zealand (Salant and Lauderdale, 2003), Germany (Razum et al., 1998), Sweden (Sundquist and Johansson, 1997) and Spain (Gimeno-Feliu et al., 2015). Some research has also reported that migrants have better outcomes in

some chronic diseases (Cunningham et al., 2008; Anikeeva et al., 2010; Siddiqi et al., 2013; Vang et al., 2017); however, existing evidence for the healthy migrant effect in relation to morbidity is largely inconsistent and even contradictory (Bzostek et al., 2006; Anikeeva et al., 2010; Aglipay et al., 2013).

The phenomenon of the healthy migrant effect is primarily explained by migration selectivity, cultural buffers of the country of origin, and the so-called 'salmon bias'. First, the migration process is highly selective. That is, healthy individuals have a higher probability and a stronger motivation to migrate, and migrant-receiving countries generally establish migration health requirements to safeguard their public health systems (Puschmann et al., 2017). Second, the cultural background of the home country might provide buffers for migrants in maintaining health advantages during acculturation process. Such buffers are healthy behaviour and social norms of migrants' home countries that remain for some time after migration (Page, 2007). Third, the so-called 'salmon bias' might artificially lead to the healthy migrant effect. This bias refers to findings that migrants who are frail, sick and elderly are likely to return to their home country, resulting in a lower number of unhealthy migrants in the host society (Abraido-Lanza et al., 1999; Palloni and Arias, 2004; Markides and Eschbach, 2005). There are also other explanations for the healthy migrant effect, such as inconsistency in counting deaths between the migrant and native populations (Smith and Bradshaw, 2006) and reporting bias of migrants given a low rate to being diagnosed for migrants upon arrival but a high one for migrants with long duration (McDonald and Kennedy, 2004). However, the precise reasons and mechanisms of the healthy migrant effect are not fully understood.

One of the most prominent characteristics of the healthy migrant effect is that this phenomenon tends to diminish over time, resulting in similar or even worse health outcomes in the migrant population than in the native-born population at old age (McDonald and Kennedy, 2004; Biddle et al., 2007). For example, in the US, compared with the US-born population, foreign-born Americans have a lower prevalence of obesity, circulatory diseases and mental health problems upon arrival, while these health advantages are not observed among migrants at old age (Cunningham et al., 2008). Similarly, in Canada, the prevalence of certain health problems, such as asthma, back pain and high blood pressure, among migrants from non-English-speaking countries increases significantly after migration, while after approximately 20 years, it plateaus to be at a similar level to that of the Canadian-born population (McDonald and Kennedy, 2004). This deterioration in migrants' wellbeing and health suggests a negative effect on health outcomes resulting from the post-migration environment. There are several factors associated with migration that could explain this deterioration in health status. First, stress associated with migration and acculturation could compromise migrants' health outcomes. Stress linked to the migration process can have long-lasting detrimental effects on migrants' psychological wellbeing. Such stress factors can be

the anxiety of navigating a visa application process that can last many years, trauma caused by exposure to violence and conflict in the country of origin, and illegal migrants' fear of exploitation after arrival in the host country (Jasso et al., 2005). Second, the pressure of adapting to a new environment can be detrimental to migrants' wellbeing; for example, migrants often experience feelings of isolation, loneliness and depression (Jasso et al., 2005). Third, with a longer duration of residence, migrants might adopt unhealthy behaviours, such as increased use of tobacco, alcohol and drugs, and greater consumption of sweetened drinks and fried and processed food, which may erode the protective effect of their original culture (Vang et al., 2017). Fourth, other adverse factors associated with the acculturation process are also likely to trigger and exacerbate the deterioration of migrants' health status, for example, migrants' limited access to health care resources (Dey and Lucas, 2006), migrants' higher poverty rate (Fennelly, 2007) and migrants' experiences of discrimination and stigmatisation (Safi, 2009). However, currently, the mechanisms behind changes in migrants' health outcomes remain unclear. Empirical evidence in relation to how migrants' health status dynamically changes over migrants' acculturation and ageing process is rare, thus hindering more nuanced understanding of migrants' wellbeing and health.

2.2 Migrants' Life Expectancy and Healthy Life Expectancy

HLE is an intuitive and meaningful population health measure. It combines information on mortality and morbidity into a single measure and has been increasingly used to measure quality of life and the efficiency and effectiveness of public health systems (Stiefel et al., 2010; Jagger and Robine, 2011). A growing body of research has recently used HLE as a new dimension to examine migrants' wellbeing and health, and shows that migrants have different health outcomes for mortality and morbidity when compared with the native-born population (Eschbach et al., 2007; Garcia and Chiu, 2016; Garcia et al., 2017; Reus-Pons et al., 2017; Garcia et al., 2018; Garcia et al., 2019).

Such research has found that migrants generally have a significantly longer LE than the native-born population, while migrants' HLE, particularly the ratio of HLE/LE, is lower than that of the native-born population (see Figure 1) (Garcia et al., 2015; Wohland et al., 2015; Reus-Pons et al., 2017; Garcia et al., 2018; Garcia et al., 2019). For example, Eschbach et al. (2007) note that foreign-born Mexican Americans have a longer LE at age 65 than do US-born Mexican Americans (16.5 vs. 15.3 years for men and 19.0 vs. 18.2 years for women), but, in contrast, their proportion of HLE in remaining life at age 65 are lower than that of their US-born counterparts (83% vs. 85% for men and 75% vs. 77% for women). Likewise, in Belgium, although migrants' LE at age 50 (28.3 years for men and 33.2 for women) exceeds that of the native-born population (27.8 years for men and 32.8 for women), migrants' HLE at age 50 (12.5 years for men and 12.8 for women) is remarkably lower than that of the Belgium-born population at the same age (14.4 years for men and 15.6 for women) (Reus-Pons et al., 2017). These findings correspond to the previously reported mortality advantage

of migrants, but suggest that migrants might not have health advantages in relation to morbidity at old age.

[Figure 1 here]

Existing research also indicates that migrants' HLE differs substantially by gender. In general, male migrants enjoy more desirable HLE outcomes, particularly in relation to the ratio of HLE/LE (Carnein et al., 2014; Garcia et al., 2017). For example, in Germany, Turkish female migrants are expected to live 5.6 years (or 20% of LE) with a physical limitation at age 50, but Turkish male migrants in Germany will live with a physical limitation for 4.8 years (or 18% of LE) at the same age (Carnein et al., 2014). The better outcomes in HLE for male migrants are more prominent for those migrating at middle age because this group is more likely to pursue occupational opportunities and therefore needs to be healthy (Garcia and Chiu, 2016).

However, despite the growing volume of research on migrants' HLE, there are still three principal limitations in this research field. First, to the best of our knowledge, current research on migrants' HLE is all conducted in the context of the US or Western European countries, with no study providing estimates of migrants' HLE in other migrant-receiving societies. This overlooks the variation of migrants' life outcomes in different destinations where migrants' pre- and post-migration environments and the composition of migrant populations differ remarkably from what is found in the US and in Western Europe (see Figure 2). Second, most existing research focuses on migrants' HLE at age 50 or age 65, with little research exploring migrants' HLE over the entire life course. This limits comprehensive understanding of changes in migrants' wellbeing and health as migrants age and acculturate into the host society. Third, existing research on migrants' HLE largely uses data from a single year rather than from multiple years. Thus, it is not possible to trace changing trends in migrants' HLE over time, which might lead to bias and also a lack of robustness of the findings. The present study fills these important gaps in the literature by examining the LE and HLE of Australian migrants and native-born Australians to provide more nuanced understanding of migrants' wellbeing and health.

[Figure 2 here]

3. Data and Methods

3.1 Data

This study uses three data sources from the Australian Bureau of Statistics (ABS) to estimate LE and HLE: annual publications of estimated resident population (ERP),[1] 1% of data randomly selected from the Census of Population and Housing (CPH),[2] and annual statistics

[1] Source: https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3101.0Jun%202018?OpenDocument

[2] Source: https://auth.censusdata.abs.gov.au/webapi/jsf/login.xhtml

of death.[3] Specifically, the total Australian population size is sourced from the ABS's published annual ERP, while the sizes of the Australia-born and overseas-born populations are derived from the 1% of data randomly selected from CPH, adjusted by the ratio of ERP to the population size of the 1% of data randomly selected from CPH. Information about the health status of the Australia-born and overseas-born populations are also captured from the 1% of data randomly selected from CPH, while data on the number of deaths of the Australia-born and overseas-born populations are obtained from the annual statistics of death published by the ABS. All data were aggregated into 11 age groups: 0 year, 1–4 years, ten-year age groups from 5–14 years to 75–84 years, and 85 years and older. The study aggregates data by ten-year age groups rather than by the commonly adopted five-year age groups because of the limited availability of death data by nativity. That is, the ABS provides data on the number of deaths by nativity in ten-year age intervals in its annual statistics of death. However, applying ten-year age groups does not affect the estimation of LE and HLE.

3.2 Measurement of Health

In CPH, health is measured by whether people need help or assistance in at least one of three core activities: self-care, mobility and communication. Self-care is defined as the ability to conduct daily activities independently, such as eating, showering, dressing or toileting; mobility is defined as the ability of body movement, such as getting out of bed and moving around at home or at places away from home; and communication is defined as the ability of understanding or being understood by others. If respondents need help or assistance in relation to any of these three core activities and the corresponding reason is because of disability, long-term health condition (lasting longer than six months), or old age, they are considered unhealthy. Respondents who have no difficulty in conducting any types of core activity are considered healthy. It should be noted that if respondents require need or assistance in any core activities, but the reason is because of a short-term health condition (lasting less than six months), deficiency in the English language (if they report difficulty in communication),[4] or from any other causes, they are considered healthy.

3.3 Methods

This study adopts the Sullivan method to compute HLE. The Sullivan method was developed by Sullivan (1971) and is widely used in research on HLE. This method is highly practical because it requires only cross-sectional data, which tend to be readily available in most countries. In addition, computation results of HLE produced by the Sullivan method are

[3] Source: https://www.abs.gov.au/AUSSTATS/abs@.nsf/second+level+view?ReadForm&prodno=3302.0&viewtitle=Deaths,%20Australia~2018~Latest~25/09/2019&&tabname=Past%20Future%20Issues&prodno=3302.0&issue=2018&num=&view=&

[4] If respondents report having difficulty of understanding or being understood only because of their deficiency in the English language rather than any health-related causes (such as disability or ageing), they are considered healthy.

similar to those produced by other methods (such as the multistate life table method) that demand sophisticated computation based on longitudinal data, providing regular and smooth transition rates of health over time (Jagger et al., 2014).

The following equation summarises the computation of LE (see Equation 1) and HLE (see Equation 2) based on the Sullivan method.

$$ {}_nLE_x = \frac{\sum_{x=0}^{\omega-n} {}_nL_x}{{}_nl_x} \quad \text{..... (Equation 1)} $$

$$ {}_nHLE_x = \frac{\sum_{x=0}^{\omega-n} (1-{}_n\pi_x) * {}_nL_x}{{}_nl_x} \quad \text{..... (Equation 2)} $$

In the equation above, x represents age, ω denotes the highest age and n the age interval of the age group. ${}_n\pi_x$ is the proportion of unhealthy people in the age group (x, $x+n$), ${}_nL_x$ is the number of person-years lived in the same age group, and ${}_nLE_x$ and ${}_nHLE_x$ are the corresponding LE and HLE. Computation procedures of ${}_nL_x$ follows the conventional life table method, which has been elaborated in standard textbooks and published papers (Chiang, 1979) and can be found in the Appendix.

4. Results

This study provides a comprehensive analysis of the LE and HLE of migrants in Australia, and the corresponding differences with the Australia-born population over the period 2006–2016. Absolute lengths of LE and HLE for the overseas- and Australia-born populations are estimated, and the corresponding nativity differences by age, gender and year are analysed. The major findings are presented below.

4.1 Crude Death Rate and Health Status of Migrant and Australia-born Population

This study first examines the distributions of crude death rate and the proportion of unhealthy status for the overseas- and Australia-born populations in 2006, 2011 and 2016. As presented in Table 1, after age standardisation (using Australian population in 2006 as the standard population, the same hereafter), the overseas-born population has a lower crude death rate and a lower proportion of unhealthy status than the Australia-born population. For example, in 2016, the aged-standardised crude death rate of the overseas-born population was 5.8 per 1,000 persons, which was lower than that of the Australia-born population (6.8 per 1,000 persons) correspondingly. Similarly, in the same year, the aged-standardised proportion of unhealthy status among the overseas-born population was 4.1%, which was also lower than for the Australia-born population (4.4% correspondingly).The lower crude death rate and lower proportion of unhealthy status of the overseas-born population were observed in the three years that were examined.

[Table 1 here]

Importantly, changes in crude death rate and proportion of unhealthy status as age increases show different patterns in the overseas-born and Australia-born populations. Specifically, while the crude death rate of the overseas-born population remains lower than that of the Australia-born population throughout all ages, the proportion of unhealthy status among the overseas-born population approximates and exceeds that of the Australia-born population at old age. These patterns were observed in all three years examined, and were more prominent for overseas-born women. For example, in 2016, while the crude death rate of the overseas-born population was lower than that of the Australia-born throughout all ages, the proportion of unhealthy status of the overseas-born population overtook that of the Australia-born population at age 55–64. This turning point occurred at age 65–74 for overseas-born men, but somewhat earlier, at age 55–64, for overseas-born women.

Contrasting changing trends in crude death rate and the proportion of unhealthy status over the one-decade study period were also observed. Specifically, between 2006 and 2016, the age-standardised crude death rate of the Australia-born and overseas-born population decreased from 6.8 to 6.1 per 1,000 persons and from 5.8 to 5.1 per 1,000 persons, respectively. In contrast, the proportion of unhealthy status of the two groups over the same period increased from 4.4% to 5.2% and from 4.1% to 4.8%, respectively.

4.2 Life Expectancy and Healthy Life Expectancy of Migrant and Australia-born Population

Table 2 and Figure 3 present the LE, HLE and ratio of HLE/LE for the Australia-born and overseas-born populations, and the corresponding nativity differences in these three indicators as age increases. As presented, the LE, HLE, and ratio of HLE/LE of the overseas-born population differ significantly from the Australia-born population, and the nativity differences of the three indicators are also clear.

Overall, the overseas-born population enjoy longer LE compared than the Australia-born at all ages, but this advantage narrows with increasing age. For example, in 2016, the LE of the overseas-born population at birth was 84.8 years, which exceeded that of the Australia-born population, which was 82.4 years in the same year. This margin plateaued at an approximately 2.2-year difference during age 0–24, after which it continuously decreased at an accelerating rate until the oldest age (see Figure 3a). At age 85 and older, this margin remained less than 0.8 years. Similar patterns were also observed in 2006 and 2011, and for both men and women. This suggests that compared with the Australia-born population, Australian migrants have a significant mortality advantage throughout their entire life course, corresponding to previous studies that note the existence of the healthy migrant effect (Cunningham et al., 2008; Anikeeva et al., 2010; Vang et al., 2017). However, it should be noted that the mortality advantage of Australian migrants thins with increasing age, particularly after approximately age 25.

Unlike the consistent advantage in LE of the overseas-born population, the differences between the HLE of Australia's overseas-born population and Australia-born population vary notably with increasing age. Specifically, the HLE of the overseas-born population exceeds that of the Australia-born by a considerable margin at birth, but this margin decreases sharply as age increases, disappearing and even becoming negative at old age. For example, in 2016, the HLE of the oversea-born population was higher than that of the Australia-born by 1.5 years at birth, and this difference remained largely stable until 25. However, after age 25, the margin diminished drastically, with the HLE of the overseas-born population decreasing to approximately that of the Australia-born population and then being overtaken by the Australia-born population at age 55–64. The margin in HLE between the two populations reached its lowest level at age 75–84 at –0.3 years, and increased moderately to zero at the oldest age group, forming a right-skewed V-shaped trajectory. This age variation in migrants' HLE suggests that the migrants' morbidity advantage significantly vary with increasing age and that migrants suffer worse morbidity outcomes in later life despite their relatively better health status at younger ages. This is in line with previous studies reporting undesirable health outcomes for elderly migrants (Cunningham et al., 2008; Vang et al., 2017), and creates further understanding by revealing the differences in morbidity outcomes between the migrant and native populations over the entire life course.

As presented in Figure 3(g), the nativity difference in ratio of HLE/LE also manifests V-shaped variation as age increases. As graphed, the ratio of HLE/LE was at similar levels for the Australia- and overseas-born populations before age 25, with the margin remaining smaller than 1%. However, after age 25, that is during age 25–84, the nativity difference in the ratio of HLE/LE increases drastically, forming a steep declining curve that reaches its lowest level at age 75–84 (–3.8% in 2006, –6.0% in 2011, and –6.7% in 2016). The trend is then reverses after age 85. This age pattern of nativity difference in ratio of HLE/LE and the pattern of nativity difference of HLE suggest that the deterioration of migrants' morbidity outcomes are significantly age-varying. Specifically, migrants have some morbidity advantage at young age, but this advantage weakens rapidly during working age, and turns negative at old age; however, at the oldest age, this reverses slightly. These patterns with increasing age suggest that acculturation and increased exposure to mainstream society might have a detrimental effect on migrants' wellbeing and health, and that this effect largely increases with age.

[Table 2 here]

[Figure 3 here]

4.3 Gender Differences of Life Expectancy and Healthy Life Expectancy

There were prominent gender differences observed in migrants' LE, HLE and ratio of HLE/LE, and these differences were also seen between nativity status. Generally, overseas-

born women enjoy both longer LE and HLE than overseas-born men; however, their ratio of HLE/LE is relatively lower. As presented in Table 2, although the LE and HLE of overseas-born women exceeded those of overseas-born men, the ratio of HLE/LE of overseas-born women was lower than that of overseas-born men by more than 2.6% at all ages, and was even more than 15.8% at old age. This suggests that female migrants, despite enjoying a longer lifespan, have a lower quality of life than do male migrants.

Additionally, when compared with the Australia-born counterparts, overseas-born women have smaller health advantages in LE and HLE and a greater disadvantage in the ratio of HLE/LE than do overseas-born men. That is, overseas-born women' had longer LE than Australia-born women by a smaller margin than overseas-born men had compared with Australia-born men at most ages (see Figure 3b and 3c). Similarly, the HLE of overseas-born women was overtaken by the HLE of Australia-born women after age 35, but the HLE of overseas-born men remained higher than that of Australia-born men throughout all ages (see Figure 3e and 3f). Moreover, for the ratio of HLE/LE, the margin between overseas-born men and Australia-born men varied in a range from 0.1% to –4%, while the corresponding margin between overseas-born women and Australia-born women was significantly larger (from –1.3% to –10%) (see Figure 3h and 3i). This suggests that the healthy migrant effect is less significant among female migrants and that female migrants' health outcomes suffer a larger and faster deterioration than those of male migrants during the acculturation and ageing process.

4.4 Changes of Life Expectancy and Healthy Life Expectancy over Time

Figure 4 presents the changing trends in LE, HLE and the ratio of HLE/LE at birth over the period 2006–2016 for the Australia-born and overseas-born populations. As presented in the figure, LE, HLE and the ratio of HLE/LE in these three years manifested contrasting changes. Specifically, while the LE of the Australia- and overseas-born populations increased from 81.1 to 82.4 years and from 83.4 to 84.8 years, respectively, during the period 2006–2016 (see Figure 4a and 4b), the HLE of the Australia- and overseas-born population remained almost unchanged, increasing very slightly from 75.8 to 76.2 years and from 77.5 to 77.7 years, respectively (see Figure 4c and 4d). Consequently, because of prolonged LE but a largely stagnant HLE, the ratio of HLE/LE decreased steadily, from 93.6% to 92.5% for the Australia-born population and from 93.0% to 91.7% for the overseas-born population over the same period (see Figure 4e and 4f). These contrasting changing trends in LE, HLE and ratio of HLE/LE imply that Australian natives and migrants are enjoying a prolonged lifespan over the study years, but that the quality of life of both these populations is worsening over time.

[Figure 4 here]

5. Conclusion and Discussion

HLE is an important health indicator that provides a summary of overall health condition at the population level. The present study contributes to the literature by providing the first analysis of LE and HLE of migrants in one of the major migrant-receiving societies and by examining age and gender patterns and the year variations. Results demonstrate that compared with the Australia-born population, migrants in Australia enjoy a longer LE at all ages and a longer HLE before age 55. However, the advantage in LE and HLE that migrants enjoy at young age narrows significantly as age increases, particularly after age 25. In addition, the ratio of HLE/LE of migrants is lower than that of the Australia-born population at all ages, and shows a sharper decline after age 25 than for the Australia-born population. The deterioration of health outcomes is more significant among female migrants, who experience an earlier, greater and faster decrease in their health status than male migrants. The study also identifies prolonged LE but a worsening quality of life during the period 2006–2016 for both the Australia- and overseas-born populations. These findings broaden current knowledge of migrants' HLE in the context of Australia, and provide new understanding about how migrants' wellbeing and health change during the acculturation and ageing process.

Results from the present study are in line with previous studies reporting the healthy migrant effect (Cho et al., 2004; Cunningham et al., 2008; Anikeeva et al., 2010; Ruiz et al., 2013; Vang et al., 2017), demonstrating that migrants in Australia enjoy strong health advantages over the Australia-born population in mortality, and to a lesser extent, in morbidity. These health advantages can be explained by factors such as the selection process for migrants and cultural buffers. For example, like many other migrant-receiving countries, Australia has established immigration health requirements, which reduces the probability of unhealthy migrants entering Australia. Additionally, the health outcomes of some Australian migrant communities are also affected by the culture of their home country. For example, two of Australia's major migrants communities, the Italian and Greek communities, largely maintain their traditional Mediterranean diet, which is reportedly associated with improved heart health and lower mortality (Anikeeva et al., 2010). In addition to these general factors, Australia's distinct migration profiles, which are largely different from those of the US and Europe, also contribute to migrants' health advantages in Australia for several reasons. First, because Australia is an island, it is able to achieve better border and immigration than many other migrant-receiving countries and therefore maintains a significantly lower level of undocumented/illegal immigrants in its total population. The proportion of undocumented/illegal immigrants to the total population of Australia is generally below 0.5% (Parliament of Australia, 1999; Department of Immigration and Multicultural and Indigenous Affairs, 2004), which is significantly lower than that of the US (4%) (Pew Research Centre, 2019a), the UK (1.2–1.8%), and Germany (1.2–1.4%) (Pew Research Centre, 2019b). This

means that a greater proportion of migrants in Australia meet the health requirements imposed by the immigration policy than is the case in the US and Europe. Second, the great majority of undocumented/illegal immigrants in Australia are visa overstayers (Parliament of Australia, 1999), while a large proportion of undocumented/illegal immigrants in the US and Europe are asylum seekers or people immigrating via illegal border crossings (Pew Research Centre, 2019a,b). Thus, most undocumented/illegal immigrants in Australia are unlikely to have suffered the negative experiences linked to illegal migration processes, such as human trafficking, exploitation and the trauma caused by experiencing war and conflict. Third, and most importantly, most Australian migrants are skilled migrants, accounting for almost 70% of the Australian migrant population (Australian Bureau of Statistics, 2019a). This is far higher than the skilled migrant percentage of 13.9% in the US (Department of Homeland Security of United States, 2019) and of 29.1% in the UK (Home Office of United Kingdom, 2019), and is even higher than the percentage of 58.0% in Canada (Department of Citizenship and Immigration Act of Canada, 2019). Skilled migrants tend to have a more favourable socioeconomic status than other types of migrants, for example, they have higher educational attainment, greater labour market participation and higher income (Boucher, 2007; Hugo, 2014). In Australia, the personal income of skilled migrants is higher than that of any other types of migrant and is also higher than that of the general Australian population (Australian Bureau of Statistics, 2019b,c). The favourable socioeconomic status of Australia's skilled migrant population may contribute to the better health outcomes of migrants observed in this study.

Results also demonstrate that migrants' health advantage at young age narrows significantly over time and that the speed of this narrowing varies with increasing age, being particularly prominent at working ages and early later life, but less significant at oldest age. This pattern is particularly significant in relation to migrants' morbidity outcomes, which manifests a right-skewed V-shaped trajectory, with migrants' morbidity advantage decreasing substantially throughout working ages and becoming negative after age 55, while increasing slightly after age 85. This finding is in line with previous studies reporting declining health outcomes of Australian migrants with longer duration of residence (Biddle et al., 2007), but provides a closer examination of the different rates of the changes in migrants' health outcomes in different life courses. Migrants' rapidly vanishing health advantage during age 25–84 might be explained by the fact that migrants become increasingly integrated into the host society during this age interval, but this integration process might be stressful given the elevated and accumulated stress throughout the process of adapting to the new social, cultural and physical environment (Jasso et al., 2005; Mui and Kang, 2006; Huijts and Kraaykamp, 2012). During this highly challenging acculturation process, adverse factors associated with acculturation, such as adoption of unhealthy behaviours, a weakened protective effect from the original culture, and discrimination and stigmatisation, might jointly undermine migrants'

health outcomes (Pierce et al., 2007; Anikeeva et al., 2010; Vang et al., 2017). Existing research indicates that during the acculturation process, Australian migrants suffer a low level of social support and experience social isolation and limited medical access (Khavarpour and Rissel, 1997; Thomas, 1999; Steel et al., 2002). These challenges might result in the rapid deterioration of migrants' health status during working ages and early later life observed in this study. In contrast, the detrimental effect of acculturation might be less pronounced for those older than age 85 given that this group has become familiar with their living environment and social networks, and have less motivation to change their living environment, thus no longer, or to a less extent, experiencing the stress associated with adapting to a new environment. This might explain why migrants at very old age have a slower rate of deterioration of health outcomes.

Another important finding is that female migrants have less health advantages than male migrants over the native-born population in both mortality and morbidity, and suffer an earlier, greater and faster health deterioration during the acculturation and ageing process than do male migrants. These gender differences suggest that female migrants are less likely to have the healthy migrant effect and are more vulnerable to the negative effects of acculturation. Female migrants' vulnerability in health outcomes might be explained by the gender differences related to pre- and post-migration environments. First, men are more likely than women to migrate for occupational opportunities, which are in general associated with health requirements and functional demands; however, women are more likely to migrate for family reunification, which does not necessarily require health examinations (Angel et al., 2010; Treas, 2015). In Australia, women represent approximately 35% of skilled migrants but 63% of migrant spouses (Boucher, 2007), suggesting a lower probability of female migrants migrating for employment and hence a weaker selectivity regime during the migration process. Second, gender difference in socioeconomic status in the country of origin might also negatively affect the health outcomes of Australian female migrants. In many developing countries, including some of the major migrant-sending countries of Australia, such as China, India, and countries in Southeast Asia (Bauer et al., 1992; Goodkind, 1995; Batra and Reio Jr, 2016), women are significantly more likely to be socioeconomically disadvantaged through factors such as lower educational attainment, lower income and less social capital, which might result in less favourable health outcomes for females in post-migration life (Ojanuga and Gilbert, 1992; Ahmed et al., 2010; Jayachandran, 2020). Third, traditional family role orientation in migrants' home countries generally consider men as the 'bread winners' (that is, the person who earns money through employment outside the home) while women are the nurturers and caregivers; such traditional roles may constrain female migrants' financial independence and acculturation level in the host society and therefore compromise female migrants' health outcomes (Garcia et al., 2015). In Australia, overseas-born women have a substantially lower employment rate (65.3%) than foreign-born men (79.7%), and than

native-born women (72.6%) (OECD Data Statistics, 2019). Evidence also demonstrates that traditional gender expectations cause a slower acculturation rate for women in some Australian migrant groups (Ghuman, 2000). This suggests that female migrants in Australia are more likely to be negatively affected by their sociocultural background in their home country, and therefore face higher stress levels during the acculturation process and have less desirable health outcomes.

This study also reveals a declined quality of life for Australian migrants and Australian natives during the period 2006–2016, reflecting that although Australians are living longer, a greater proportion of their lifetime is spent in an unhealthy state, regardless of place of birth. This finding mirrors previous studies demonstrating that the Australian population is living longer but more unhealthily (Davis et al., 2002; Lynch et al., 2007), and further demonstrates that this declining trend in quality of life also occurs regardless of migration background. This declining trend in quality of life echoes the theory of 'expansion of morbidity', which permissively holds that people are more likely to live with illness and experience a longer but sicker life because of medical advances and declined mortality. This phenomenon is dubbed the 'failure success' (Gruenberg, 1977) and represents a trade-off between 'longer life' and 'worsening health' (Olshansky et al., 1991). The concerning trends in quality of life among Australian migrants and natives should draw increased attention from both policymakers and health care providers, demonstrating that it is necessary and might be more important to increase efforts to improve the quality of life of the Australian population in addition to the traditional efforts towards extending lifespan.

The findings from this study have important implications for health policy in Australia and elsewhere. First, policymakers are advised to adopt life-course approaches to mitigate the negative effects of acculturation on migrants' health outcomes. Efforts should be taken to prevent migrants' undesirable health outcomes in later life by supporting migrants from young age. Special policy and practice developments are needed to target young migrants at working ages experiencing pressure in adapting to the new environment. This study suggests introducing pertinent measures, such as providing a supportive environment, offering timely mental health intervention, and increasing accessibility of health care services that consider cultural and linguistic diversity. Second, attention should also be focused on assisting female migrants to enhance their wellbeing and health. Providing support to increase female migrants' social participation and employability and to promote gender equality should be prioritised in the government's agenda. Third, the public health system must focus more effort on controlling morbidity in addition to existing efforts to reduce mortality. Measurements to improve quality of life, such as providing accessible and acceptable health assistance and promoting healthy lifestyles, are needed for better outcomes of population health.

There are some limitations of this study that must be acknowledged. First, by using the life table method and the Sullivan method, the study assumes population in a specific year as

a hypothetical cohort, which means that the mortality and morbidity prevalence in a specific year are considered to represent what is actually experienced by a real cohort of the population over the life course. Thus, the LE and HLE computed in this study are based on data of overlapping generations in a specific period rather than on the data of a real cohort of the population. However, the life table method and the Sullivan method are standard methods used to calculate LE and HLE and have been widely used in the literature (Chiang, 1984). Future research is recommended to explore changes in migrants' wellbeing and health based on longitudinal data if such data become available. Second, this study considers migrants as a whole but has not explored differences in HLE by migrants' country of origin. Previous studies suggest that migrants' wellbeing and health exhibit different patterns by their country of birth and ethnicity because of different sociocultural backgrounds (Huijts and Kraaykamp, 2012; Wohland et al., 2015). It would be interesting and useful for future research to explore the nativity and ethnicity differences in migrants' HLE. Despite these limitations, this study provides the first examination of migrants' HLE in one of the world's major migrant-receiving societies, and provides more nuanced understanding of the changing health outcomes of migrants during the acculturation and ageing process. Results provide new insights into migrants' wellbeing and health from the new perspective of quality of life, informing future policy in aiming to improve migrants' life outcomes in Australia and in other migrant-receiving societies.

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Tables

Table 1 Crude Death Rate (CDR) and Unhealthy Status by Age Group and Sex for Australia- and Overseas-born Population, 2006, 2011 and 2016

	CDR (per 1000 persons)						Unhealthy Status (%)					
	Male		Female		Both		Male		Female		Both	
Age group	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB
	2006								**2006**			
0	5.4	1.6	4.2	0.0	4.8	0.8	0.3	1.2	0.3	0.1	0.3	0.5
1-4	0.2	0.0	0.2	0.1	0.2	0.1	1.4	1.5	0.9	0.1	1.1	0.8
5-14	0.1	0.1	0.1	0.0	0.1	0.1	2.8	1.8	1.5	0.4	2.2	1.1
15-24	0.7	0.5	0.3	0.2	0.5	0.3	1.8	0.8	1.3	0.5	1.6	0.6
25-34	1.0	0.6	0.4	0.3	0.7	0.4	1.7	0.8	1.4	0.6	1.6	0.7
35-44	1.6	1.0	0.8	0.6	1.2	0.8	2.4	1.4	2.0	1.3	2.2	1.4
45-54	3.2	2.3	1.9	1.5	2.6	1.9	3.2	2.6	3.0	2.8	3.1	2.7
55-64	7.2	6.2	4.3	3.6	5.7	4.9	5.9	5.6	4.5	5.0	5.2	5.3
65-74	19.8	16.2	11.4	9.7	15.4	13.1	7.7	8.4	7.2	10.4	7.5	9.4
75-84	57.5	49.1	36.9	34.2	45.5	41.3	18.4	19.6	22.0	29.2	20.5	24.7
85≤	161.5	142.6	136.2	116.9	144.0	126.1	44.2	42.8	56.9	58.8	53.0	53.1
Total (age standardised)	8.3	6.9	5.6	4.8	6.8	5.8	4.4	3.9	4.2	4.3	4.4	4.1
	2011								**2011**			
0	4.3	1.4	3.6	0.9	4.0	1.1	0.3	0.3	0.3	0.3	0.3	0.4
1-4	0.2	0.2	0.2	0.1	0.2	0.1	1.6	1.5	1.0	0.3	1.3	0.9
5-14	0.1	0.1	0.1	0.1	0.1	0.1	3.7	2.3	1.9	0.7	2.8	1.5
15-24	0.6	0.4	0.3	0.1	0.4	0.3	2.4	1.0	1.6	0.6	2.0	0.8
25-34	1.0	0.5	0.4	0.2	0.7	0.4	1.9	0.7	1.6	0.6	1.8	0.6
35-44	1.5	0.8	0.9	0.6	1.2	0.7	2.5	1.3	2.3	1.5	2.4	1.4
45-54	3.1	2.1	2.0	1.3	2.6	1.7	3.6	2.7	3.5	3.3	3.5	3.0
55-64	7.0	6.0	4.1	3.4	5.5	4.7	6.0	5.8	5.2	6.2	5.6	6.0
65-74	16.9	15.2	10.4	9.2	13.5	12.3	9.0	9.8	7.7	11.4	8.3	10.5
75-84	52.8	47.0	34.7	29.1	42.5	37.6	17.9	21.7	21.5	30.1	20.0	26.1
85≤	159.9	141.8	136.1	116.5	143.9	126.1	43.6	44.6	55.8	60.4	51.8	54.4
Total (age standardised)	7.8	6.7	5.5	4.5	6.5	5.5	4.8	4.2	4.5	4.7	4.7	4.5
	2016								**2016**			
0	3.4	1.0	2.8	0.0	3.1	0.6	0.4	0.5	0.3	0.6	0.3	0.5
1-4	0.2	0.1	0.1	0.2	0.2	0.1	1.8	2.1	1.1	0.6	1.4	1.3
5-14	0.1	0.1	0.1	0.1	0.1	0.1	4.8	3.2	2.4	1.2	3.6	2.2
15-24	0.5	0.4	0.2	0.2	0.4	0.3	3.3	1.4	2.1	0.8	2.7	1.1
25-34	0.9	0.4	0.5	0.2	0.7	0.3	2.4	0.8	2.0	0.7	2.2	0.7
35-44	1.7	0.8	0.9	0.5	1.3	0.6	2.8	1.3	2.8	1.6	2.8	1.4
45-54	3.1	2.1	1.9	1.3	2.5	1.7	4.0	3.0	4.1	3.6	4.0	3.3
55-64	6.8	5.2	4.0	3.0	5.4	4.1	6.0	5.8	5.9	7.0	5.9	6.4
65-74	15.5	13.6	9.5	8.1	12.4	10.9	9.6	10.2	8.4	11.7	9.0	10.9
75-84	47.2	40.9	31.9	27.5	38.7	34.0	18.1	21.4	21.0	30.5	19.7	26.1
85≤	151.2	134.7	130.8	116.5	137.9	123.9	43.0	45.8	55.2	62.4	50.9	55.6
Total (age standardised)	7.3	6.0	5.2	4.3	6.1	5.1	5.3	4.5	5.0	5.1	5.2	4.8

Note: 'AUB' is 'Australia-born' and 'OVB' is 'overseas-born'; age standardisation uses Australian population in 2006 as the standard population.

Table 2 LE, HLE and Ratio of HLE/LE of Australia- and Overseas-born Population by Age Groups and Sex, 2006, 2011 and 2016

Age Group	LE (years)						HLE (years)						Ratio of HLE/LE (%)					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB	AUB	OVB
	2006																	
0	78.5	81.2	83.5	85.6	81.1	83.4	74.1	76.6	77.6	78.5	75.8	77.5	94.3	94.3	93.0	91.7	93.6	93.0
1-4	77.9	80.3	82.8	84.6	80.4	82.4	73.5	75.7	76.9	77.5	75.2	76.6	94.3	94.3	92.9	91.6	93.5	92.9
5-14	74.0	76.3	78.9	80.7	76.5	78.4	69.6	71.8	73.0	73.5	71.3	72.6	94.0	94.1	92.6	91.2	93.2	92.6
15-24	64.1	66.4	68.9	70.7	66.6	68.5	60.0	62.1	63.2	63.6	61.6	62.8	93.5	93.4	91.7	90.0	92.5	91.6
25-34	54.5	56.7	59.1	60.8	56.9	58.7	50.5	52.4	53.5	53.8	52.0	53.0	92.7	92.4	90.5	88.4	91.5	90.3
35-44	45.0	47.0	49.4	51.0	47.3	48.9	41.2	42.8	43.9	43.9	42.5	43.3	91.4	91.0	88.9	86.2	90.0	88.5
45-54	35.7	37.5	39.7	41.2	37.8	39.3	32.0	33.3	34.4	34.3	33.2	33.8	89.7	88.9	86.6	83.2	87.9	85.9
55-64	26.7	28.2	30.4	31.8	28.6	30.0	23.2	24.2	25.3	25.0	24.2	24.6	87.0	85.9	83.1	78.8	84.7	82.1
65-74	18.3	19.7	21.5	22.8	20.0	21.2	15.2	16.0	16.6	16.3	15.9	16.1	82.9	81.4	77.2	71.5	79.5	75.9
75-84	11.2	12.3	13.5	14.6	12.5	13.5	8.2	8.9	8.8	8.5	8.5	8.7	73.7	72.4	65.0	58.5	68.2	64.3
85≤	6.2	7.0	7.3	8.6	6.9	7.9	3.5	4.0	3.2	3.5	3.3	3.7	55.8	57.2	43.1	41.2	47.0	46.9
	2011																	
0	79.4	81.7	83.8	86.2	81.7	83.9	74.5	76.6	77.6	78.4	76.1	77.5	93.8	93.8	92.6	90.9	93.1	92.3
1-4	78.8	80.8	83.1	85.3	81.0	83.0	73.8	75.8	76.9	77.4	75.4	76.6	93.7	93.7	92.5	90.8	93.1	92.2
5-14	74.8	76.9	79.2	81.4	77.1	79.0	69.9	71.9	73.0	73.5	71.5	72.6	93.5	93.5	92.2	90.3	92.8	91.9
15-24	64.9	67.0	69.3	71.4	67.1	69.1	60.4	62.2	63.3	63.6	61.8	62.9	93.1	92.8	91.3	89.1	92.1	90.9
25-34	55.2	57.2	59.4	61.5	57.4	59.3	50.9	52.5	53.6	53.8	52.3	53.1	92.2	91.7	90.1	87.4	91.1	89.5
35-44	45.7	47.5	49.7	51.7	47.8	49.5	41.6	42.8	43.9	43.9	42.8	43.3	91.0	90.1	88.5	85.0	89.6	87.5
45-54	36.4	37.8	40.1	41.9	38.3	39.8	32.4	33.2	34.5	34.3	33.5	33.8	89.1	87.9	86.2	81.8	87.4	84.8
55-64	27.4	28.5	30.8	32.4	29.1	30.4	23.6	24.1	25.5	25.0	24.6	24.6	86.4	84.5	82.8	77.2	84.3	80.7
65-74	19.0	20.0	21.8	23.4	20.5	21.6	15.6	15.9	16.9	16.4	16.2	16.1	82.3	79.5	77.2	70.0	79.2	74.4
75-84	11.5	12.5	13.7	15.1	12.8	13.8	8.5	8.8	9.0	8.6	8.8	8.7	74.0	70.3	65.5	57.1	68.8	62.8
85≤	6.3	7.1	7.3	8.6	6.9	7.9	3.5	3.9	3.2	3.4	3.4	3.6	56.4	55.4	44.2	39.6	48.2	45.6
	2016																	
0	80.2	82.8	84.5	86.8	82.4	84.8	74.7	77.2	77.8	78.4	76.2	77.7	93.2	93.2	92.0	90.3	92.5	91.7
1-4	79.4	81.9	83.7	85.8	81.6	83.8	73.9	76.3	77.0	77.4	75.4	76.8	93.1	93.1	91.9	90.2	92.4	91.6
5-14	75.5	78.0	79.8	81.9	77.7	79.9	70.1	72.4	73.1	73.4	71.5	72.9	92.8	92.8	91.6	89.7	92.1	91.3
15-24	65.6	68.1	69.8	71.9	67.7	69.9	60.6	62.8	63.3	63.6	62.0	63.2	92.4	92.2	90.7	88.5	91.5	90.3
25-34	55.9	58.3	60.0	62.0	58.0	60.1	51.2	53.1	53.7	53.8	52.4	53.5	91.7	91.1	89.5	86.7	90.5	88.9
35-44	46.4	48.5	50.2	52.1	48.3	50.3	41.9	43.4	44.1	44.0	43.0	43.7	90.4	89.5	87.8	84.3	89.0	86.9
45-54	37.1	38.9	40.7	42.4	38.9	40.6	32.8	33.9	34.8	34.3	33.8	34.1	88.5	87.1	85.5	81.0	86.8	84.0
55-64	28.1	29.6	31.3	32.9	29.8	31.2	24.1	24.8	25.7	25.1	24.9	24.9	85.8	83.7	82.1	76.3	83.7	79.9
65-74	19.7	20.9	22.4	23.7	21.1	22.3	16.1	16.4	17.2	16.4	16.6	16.4	81.5	78.6	76.7	69.1	78.7	73.6
75-84	12.2	13.2	14.2	15.3	13.3	14.3	9.0	9.2	9.3	8.6	9.1	8.9	73.6	69.5	65.6	56.0	68.8	62.1
85≤	6.6	7.4	7.6	8.6	7.3	8.1	3.8	4.0	3.4	3.2	3.6	3.6	57.0	54.2	44.8	37.6	49.1	44.4

Note: 'AUB' is 'Australia-born' and 'OVB' is 'overseas-born'.

Figures

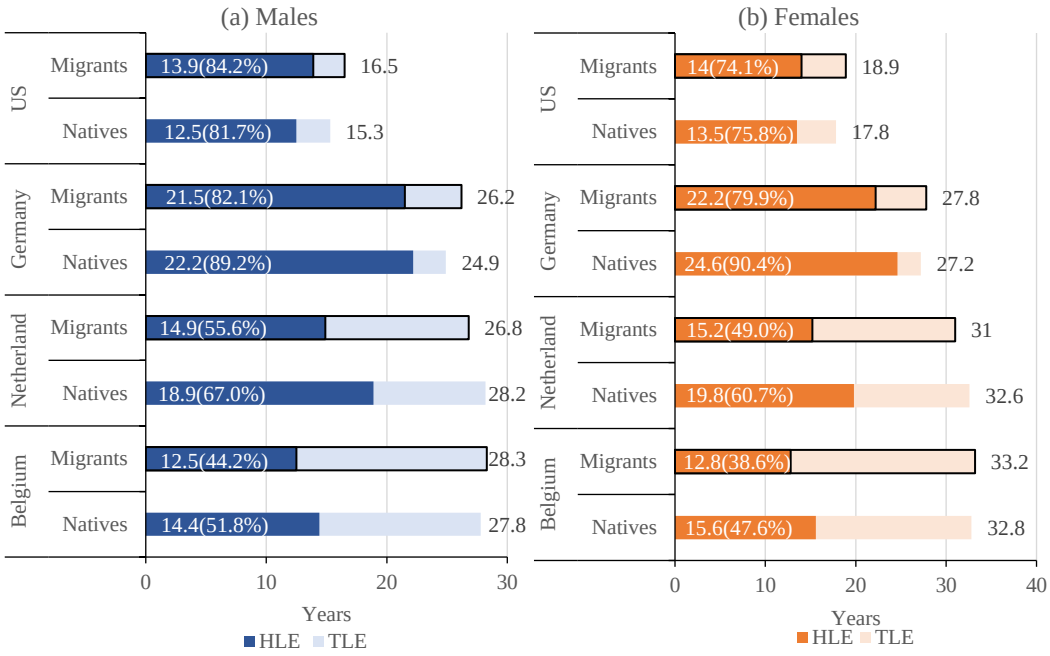

Figure 1 LE, HLE and Ratio of HLE/LE for Migrants and Non-migrants in Four Countries

Note: US data were sourced from Garcia et al. (2015), comparing LE and HLE between US- and foreign-born Mexicans at age 65 during the period 1993–2011, measuring health by activities of daily living; German data were sourced from Carnein et al. (2014), comparing LE and HLE between German natives and Turkish migrants at age 50 in 2005–2006, measuring health by self-reported limitation status; Data from Belgium and The Netherlands were sourced from Reus-Pons et al. (2017), comparing LE and HLE between natives and migrants at age 50 in 2001, measuring health by self-rated health.

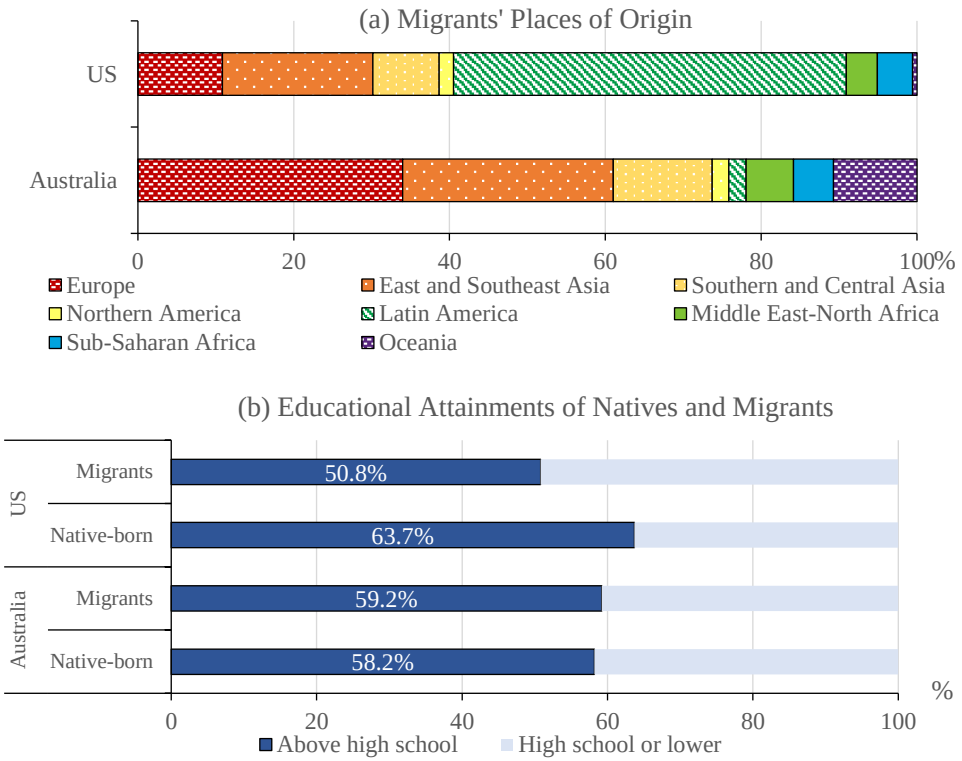

Figure 2 Differences by Nativity and in Educational Attainment between the Overseas-and Native-born Populations in Australia and the US

Note: Data were derived from the Census of Population and Housing 2016 for Australia and from the Pew Research Center tabulations of the 2018 American Community Survey for the US

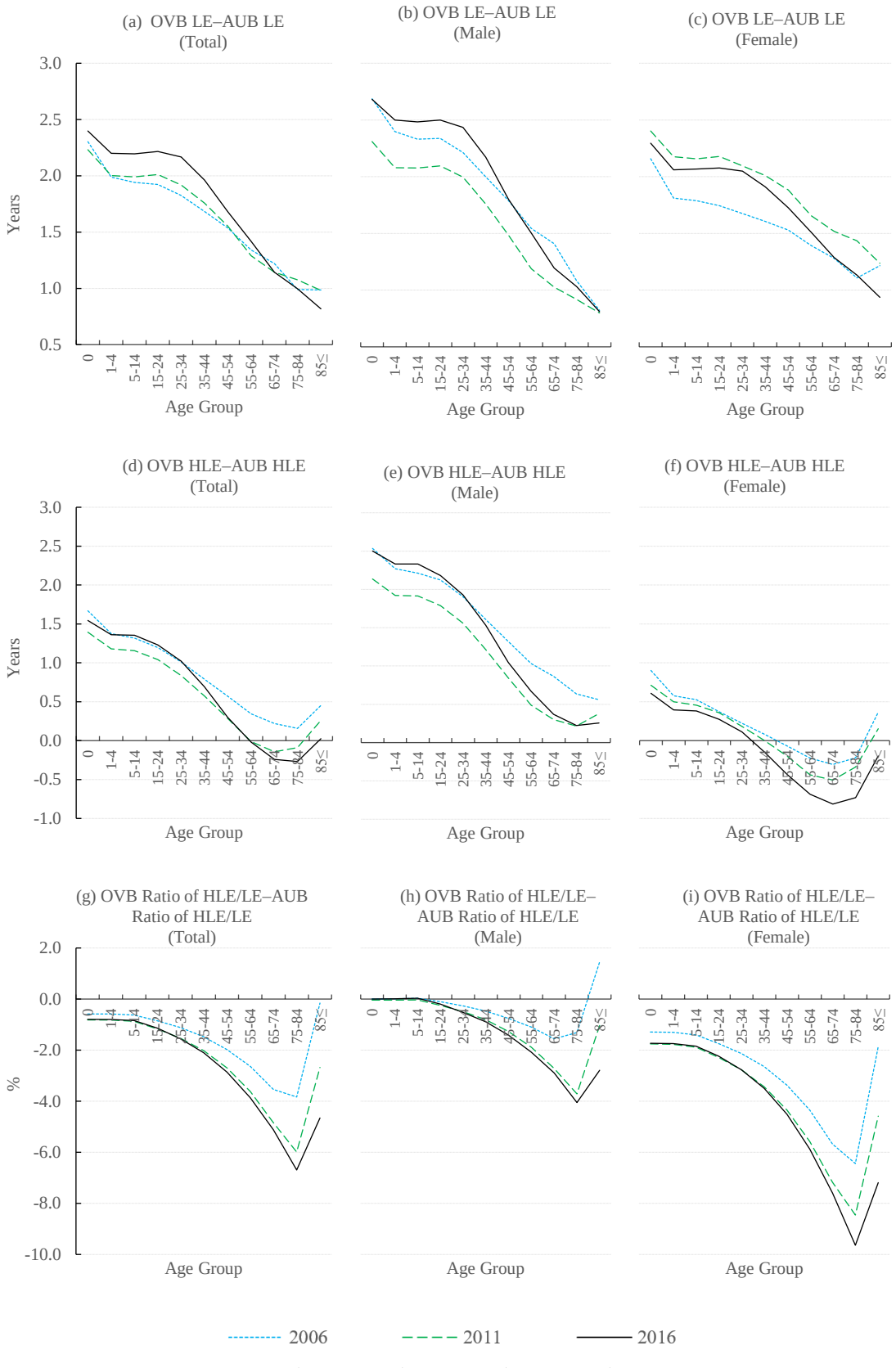

Figure 3 Gaps in LE, HLE and Ratio of HLE/LE between Overseas- and Australia-born Population

Note: 'AUB' is 'Australia-born' and 'OVB' is 'overseas-born'.

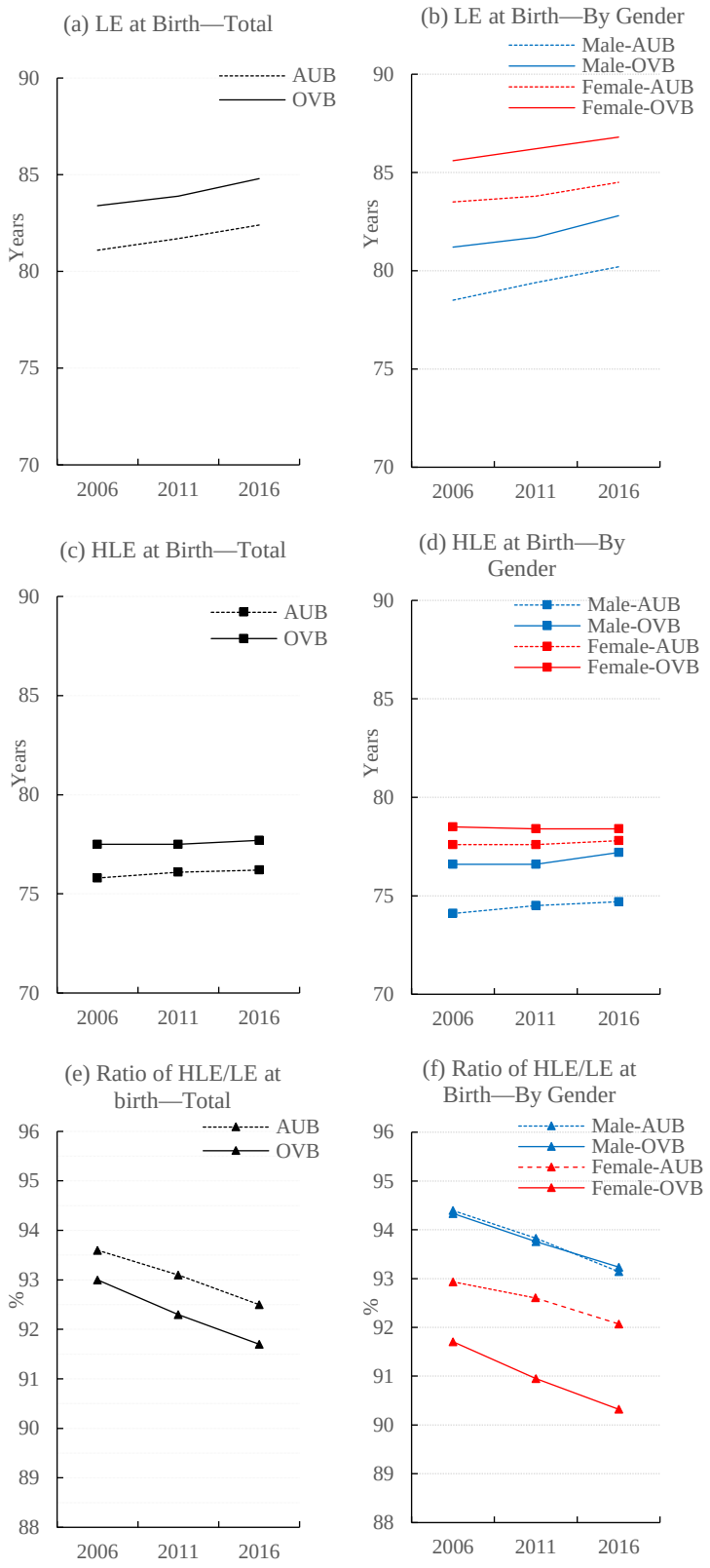

Figure 4 Changing Trends in LE, HLE and the Ratio of HLE/LE at Birth from 2006 to 2016 for Australia- and Overseas-born Population

Note: 'AUB' is 'Australia-born' and 'OVB' is 'overseas-born'.

Appendix

Following the conventional life table method proposed by Chiang (1979), ${}_nL_x$, the person-years lived between age *x* and *x+n*, can be computed through the following equations.

Let ${}_nm_x$, ${}_nP_x$, and ${}_nD_x$ represent the mortality, population size, and the number of deaths of the age group of (*x*, *x+n)*, respectively. Then, ${}_nm_x$ can be computed by Equation (1)

$$ {}_nm_x = \frac{{}_nD_x}{{}_nP_x} \quad \text{..... (Equation 1)} $$

Then, probability of death ${}_nq_x$ can be obtained by Equation (2):

$$ {}_nq_x = \frac{n*2{}_nm_x}{2+n*{}_nm_x} \quad (q\text{=1 for age group } [\omega - n, \omega]) \text{ ..... (Equation 2)} $$

Based on ${}_nq_x$, indicators of ${}_nd_x$ (the number of deaths for the age group [*x*, *x+n*]) and ${}_nl_x$ (the number of surviving persons for the age group [*x*, *x+n*]) can be obtained through the following Equation (3) and (4):

$$ {}_nd_x = l_x * {}_nq_x \text{..... (Equation 3)} $$

$$ {}_nl_x = l_x - {}_nd_x \text{..... (Equation 4)} $$

In the above two equations, l_x denotes the number of surviving persons at age *x*.

Then, based on l_x, ${}_nl_x$, and ${}_nd_x$, ${}_nL_x$ can be obtained via Equation (5).

$$ {}_nL_x = \frac{n*(l_x - {}_nl_x)}{2}, ({}_1L_0 = 0.276*l_0 - 0.724*l_1, {}_nL_{\omega-n} = \frac{{}_nl_{\omega-n}}{{}_nd_{\omega-n}}) \text{... (Equation 5)} $$