



Investigating the nativity differences in the development of disability in Australia: findings from a nationally representative longitudinal survey

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Abstract

Using data from multiple waves of the Household Income and Labour Dynamics in Australia survey, and Cox regression model with time-varying covariates, this study investigates how Foreign-Born men and women from english speaking (ES) and non-english speaking (NES) countries differ in their trajectories in developing long-term disability relative to Native-Born Australians. The results indicate that the risk of developing long-term disability increased with duration of residence among men from both ES countries and NES countries and women from NES countries, starting with a health advantage when their duration of residence was less than or equal to 10 years. However, they all lost their initial health advantage after 10 years or more years of their stay in Australia. We also found a mediating role of socioeconomic factors and English language proficiency in developing long-term disability for immigrant men and women from ES countries and immigrant women from NES countries respectively.

Keywords Australia · Migrants · Disability · Longitudinal · Duration of residence

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Introduction

Approximately, 15% of the world population have some form of disability (World Health Organization, 2011). While there is no universally accepted definition of disability, World Health Organisation has provided a 'hybrid' conceptual model (the international classification of Functioning, Disability and Health (ICF)) combining the 'medical' and 'social' model. It uses disability as an umbrella term for any impairment, activity limitation and participation restriction which limits functioning within contextual (personal and environmental) factors' (Palmer & Harley, 2012). Disability can seriously affect people who are suffering from it and their family members in many ways including their participation in major life areas of education, employment and social participation (World Health Organization, 2011). While disability can seriously affect people both socially and economically, it comes with a greater cost to immigrants than non-immigrants with disabilities. Immigrants with a disability may face double or triple jeopardy when combined with a high level of pre- and post-migration stress (Jasso et al., 2005), and the challenges they face in the country of destination such as lack of proficiency in the host country's language, discrimination, social exclusion, and lower income and employment issues (Bauder, 2014; Setia et al., 2011b). Because of these barriers and challenges, "the impact of disability on quality of life might be greater amongst immigrants" (Newbold & Simone, 2015).

Many observational studies have examined healthy migrant effect and have shown associations between migration, duration of residence, and health in Australia (Anikeeva et al., 2010; Jatrana et al., 2018), North America (Argeseanu Cunningham et al., 2008; De Maio, 2010; Hyman, 2007), and Europe (Diaz et al., 2015; Helgesson et al., 2019; Lubbers & Gijsberts, 2019). However, there is a lack of research on the nativity differences in disability in either Australia or elsewhere (Anikeeva et al., 2010; Newbold & Simone, 2015). While there are two separate strands of research on disability and on immigration, however, little attention has been paid to pull these together (Albrecht et al., 2009). Generally, with few exceptions (Cabieses et al., 2012; Huang et al., 2011; Newbold & Simone, 2015), the existing research has examined the overall pattern, and trends of disability either at the national population level with a focus on race/ethnicity/nativity and older populations or among specific immigrant subgroups (Chen et al., 1996; Dallo et al., 2009; Elo et al., 2011; Garcia et al., 2019; Jones, 2012; Manton & Gu, 2001; Mutchler et al., 2007; Melvin et al., 2014; Osman & Walsemann, 2013; Parakulam et al., 1992; Sheftel, 2017; Siordia, 2015).

The limited research from the US, Canada and Chile has suggested that compared to native-born, immigrants generally have a lower prevalence of any disability and severe disability (Newbold & Simone, 2015), visual and physical disability (Cabieses et al., 2012), mental disability and physical disability (Huang et al., 2011). However, immigrants from selected regions of origin were more likely to report work disability (Huang et al., 2011) and there were variations depending upon the severity of disability, ethnic group of immigrants and the age group considered (Chen et al., 1996; Elo et al., 2011). Age, low socio-economic

status (SES), education level, employment status, English proficiency and marital status were some of the important predictors of disability among immigrants and native born (Cabieses et al., 2012; Huang et al., 2011; Newbold & Simone, 2015). Past research has also shown that the health advantage of immigrants decreased with longer duration of stay in the host country (Cabieses et al., 2012; Huang et al., 2011; Newbold & Simone, 2015).

Given most disabilities develop much later in life, some researchers have investigated disability levels among older groups and different ethnic groups and documented the heterogeneity in disability outcomes among older immigrant, ethnic groups and by generation status (Dallo et al., 2009; Mutchler et al., 2007; Melvin et al., 2014; Osman & Walsemann, 2013; Sheftel, 2017; Jones 2012). More recently, Garcia et al (2019) assessed the heterogeneity in the immigrant health advantage by age of migration and gender (Garcia et al., 2019). They found that migrant health selectivity depends on both gender and age of migration.

Gender has been considered one of the factors potentially influencing perception of disability, although previous research on this topic produced mixed findings. Jones found that among immigrants of various generation, males exhibit lower average Instrumental Activities of daily Living (IADL) limitations but are no different than females in the average number of ADL (Activities of daily Living) limitations (Jones, 2012). However, Newbold and Simone (2015) did not find any statistical difference in the likelihood of males and females reporting a disability although older female immigrants were much more likely than immigrant males to report a disability. They also found that immigrant females were, more likely to report a severe disability (Newbold & Simone, 2015). Sheftel (2017) reported that older foreign-born females, across national origin groups have higher disability rates than older foreign-born males from the same country (Sheftel, 2017). Garcia et al. (2019) found women who migrate in late life (i.e., after the age of 50) are more likely to have an IADL disadvantage. This may be because women are more likely to be migrating for family reunification, hence not selected for health reasons. (Markides et al., 2007; Angel et al., 2010; Treas, 2014).

A major limitation of much of the past research has been the use of on cross-sectional data, which can produce biased estimates as the factors that affect the disablement process can change over time. Additionally, even less is known about the factors that contribute to the difference in disability among migrants and non-migrants over time. However, examining nativity gap in the development of disability over time, is an important global issue given high levels of immigrants globally (United Nations, 2017) and the significant contribution of disability to the global burden of disease and economic and social costs of disability to society (OECD, 2010; World Health Organization, 2011). While substantial gaps remain in employment, education and access to healthcare between people with disabilities and others (Emerson, et al. 2018; United Nations Department of Economic & Social Affairs Disability, 2023), immigrants with disabilities face additional challenges in navigating the complexities of a new country, culture, and language. Research has also revealed that particular sub-groups of immigrants, and in particular immigrant females, severely disabled immigrants, are less likely to use support for disability after controlling for other correlates of use (Hansen et al.,

2018). Examining disability among immigrants can lead to a better understanding of challenges they face and can provide insight into how to best support them. This is important given a major focus of United Nations 2030 Agenda for Sustainable Development has been to ‘leave no one behind’ to drive equality and inclusion for people with disability (United Nations General Assembly, 2015). Additionally, the evidence that disabled immigrants are more likely to experience poverty and unemployment, and have lower educational attainment than their non-disabled peers (Cabieses et al., 2012; Huang et al., 2011; Newbold & Simone, 2015) points to a need for changes in practice in terms of providing culturally-sensitive services that are delivered in a manner that is accessible to them. Providing evidence about nativity difference in disability is a first step to ensure that disabled immigrants have access to the right services to help them integrate into their new lives.

Additionally, this is an important issue in Australia where foreign-born individuals made up 26% of the total population (23 million), where approximately 18% of the total population (i.e., an estimated 4 million people) reported having some type of disability (AIHW, 2019) and where immigrants experienced a higher level of profound and severe disability (Zhou, 2016). Furthermore, in keeping with many countries, skilled migrants selected under a point-based system (with points for language, education, age and skills) make up around 60% of all migrants in Australia. Most migrants in Australia undergo medical screening to satisfy the health requirement specified in the Migration Regulations (Department of Immigration and Border Protection, 2022). The migration regulations contain a list of prescribed health conditions, which would exclude persons from migration (Department of Immigration and Border Protection, 2022).

Using Household Income and Labour Dynamics in Australia (HILDA) Survey, a nationally representative longitudinal dataset, the present study has the following aims:

1. Does the risk of developing long-term disability differ by nativity status (native-born (NB) Australians), foreign-born (FB) individuals from English speaking countries (ESC) and non-English speaking countries (NESC)?
2. Does the risk of developing long-term disability vary by nativity and duration of residence (DoR)?
3. Is the association between nativity, duration of residence and the risk of developing long-term disability mediated by English language proficiency, socio-economic status and health behaviour factors?

Disability is a dynamic concept and there are many pathways that could impact the health of immigrants with longer duration of residence in the host country. Researchers have often focussed on acculturation as a possible explanation for any decline in health with years in the host country (Ryder et al., 2000). In this study, we use DoR as a measure of acculturation, and English language proficiency, socioeconomic status and health behaviour as paths/mechanisms that might mediate the relationship between DoR and disability. Knowing about the

presence of a mediated effect in analysis is important because it helps gaining insights into the mechanisms of exposure-outcome effects (Mackinnon, 2008).

There are reasons to believe that migration background affects these mediating factors which in turn affect disability acquisition. For example, research has provided reasonably good evidence that higher socioeconomic status, high proficiency in the host country's language and healthy lifestyle behaviours are associated with better health status (Morales et al., 2002; Abraído-Lanza et al., 2005; McDonough et al., 2010; Richardson et al. 2010; Salinas et al. 2014; Tegegne 2018). Research has also shown that immigrant background is associated with language barriers, poor socioeconomic status and unhealthy health behaviour, such as smoking, drinking and exercise, which can directly affect disability (Morales et al., 2002; Abraído-Lanza et al., 2005; Tegegne 2018). However, the pathways by which the mediating factors relate to disability acquisition is complex and may operate through several mechanisms. For example, migrants with limited English proficiency, particularly those from non-English speaking countries, may face barriers to communicate their needs to healthcare professional, government officials and employers (Stronks et al., 2001; Kandula et al., 2004), making it difficult to convey their needs, understand the documents related to their disability process and negotiate services to support them. Additionally, low English proficiency can limit access to education, employment opportunities, thus preventing them fully integrating into the host society.

Methods

Data and measures

We used waves 1 to 13 data from the Household Income and Labour Dynamics in Australia (HILDA) survey. The HILDA sample and data collection instruments are described in detail elsewhere (Summerfield et al., 2014; Watson and Wooden, 2012), The HILDA survey began in 2001 and comprised a nationally representative longitudinal survey of people aged 15 years and above from 7,682 households. Relevant data from all the available members of these households aged 15 years and above ($n=13,969$) were collected in wave 1 and in subsequent waves, using the Person Questionnaire (PQ) and the Self-Completion Questionnaire (SCQ). Data was collected from all the available members of these households aged 15 years and above ($n=13,969$) in wave 1 and in subsequent waves, and covered information about demographics, economic, family dynamics and health including questions on disability.

The outcome for this study is long-term disability. As a part of personal questionnaire, all the HILDA participants were asked '*...Do you have any impairment, long-term health condition or disability such as these [shown list] that restricts you in your everyday activities and has lasted or is likely to last for 6 months or more?*'.

The shown list includes the following 17 health conditions.

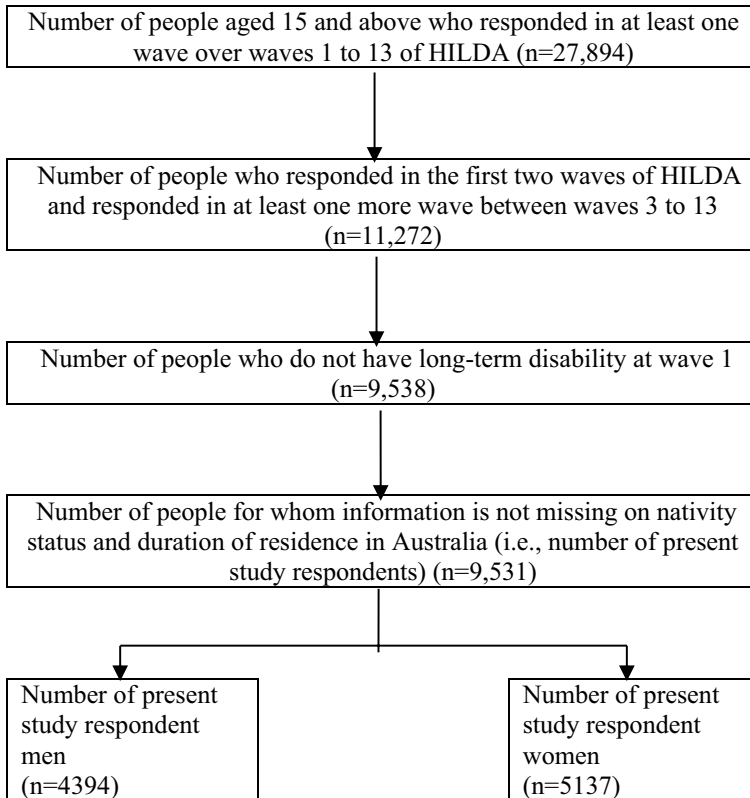
1. Sight problems not corrected by glasses/lenses
2. Hearing problems

3. Speech problems
4. Blackouts, fits, or loss of consciousness
5. Difficulty learning or understanding things
6. Limited use of arms or fingers
7. Difficulty gripping things
8. Limited use of feet or legs
9. A nervous or emotional condition that requires treatment
10. Any condition that restricts physical activity or physical work (e.g., back problems, migraines)
11. Any disfigurement or deformity
12. Any mental illness that requires help or supervision
13. Shortness of breath or difficulty breathing
14. Chronic or recurring pain
15. Long-term effects as a result of a head injury, stroke, or other brain damage
16. A long-term condition or ailment that is still restrictive even though it is being treated or medication being taken for it
17. Any other long-term condition such as arthritis, asthma, heart disease, Alzheimer disease, dementia, etc.

For this study, following Milner et al. (2014), we have considered a respondent as having long-term disability if he/she has reported one or more of the above mentioned 17 problems, in at least two successive waves of HILDA.

The selection of present study respondents from HILDA survey respondents was outlined in Fig. 1. In brief, in this study, all men and women who do not have long-term disability in wave 1, i.e., those who have not reported disability in waves 1 and 2, were followed to check whether the risk of developing long-term disability during waves 3 to 12 vary by their nativity status and by their duration of residence in Australia or not. With the above criteria, this study uses unbalanced panel data on those 4394 men and 5137 women who have responded in both waves 1 and 2, have no long-term disability in wave 1, and have responded in at least one more wave between waves 3 to 13. Thus, out of 13,969 people who reported no disability at wave 1, and who also responded in wave 2 and in at least one more wave between waves 3 to 13, were only considered ($n=9,531$). Of the 9,531 study respondents who responded at wave 1, only 6,912 (72.5%) respondents remained by wave 13, corresponding to an overall attrition of 27.5% of wave 1 sample. The retention rate of NB, FB from ES countries and FB from NES countries are 73.5%, 70.8% and 68.4% respectively. The attrition for NB men, FB men from ES countries and the FB men from NES countries are 27.4%, 30.3%, and 34.1% respectively. Similarly, attrition for NB women, FB women from ES countries and the FB women from NES countries are 25.9%, 28.1% and 29.6% respectively. Overall, attrition is slightly higher among male respondents (28.5%) than among female respondents (26.4%).

Time of incidence of long-term disability since wave 1 was calculated for each of the study respondents. If a person did not experience a long-term disability over the observed period, then the actual time of incidence of long-term disability was considered as censored. If a respondent has missing information on disability status in two



Note: This study uses conditional unbalanced panel data from HILDA survey

Fig. 1 Selection of present study respondents from HILDA survey

successive waves, say in 5 and 6, then the period observed is recorded as 4 and the actual time for the incidence of long-term disability was considered as censored.

Nativity and duration of residence in Australia are the main exposure variables considered in this study. Nativity status was categorised as native-born, foreign-born (FB) people from English speaking (ES) countries and foreign-born people from non-English speaking (NES) countries. Duration of residence was divided into: “ES; duration of residence < 10 years”, “ES; duration of residence 10–19 years”, “ES; duration of residence \geq 20 years”, “NES; duration of residence < 10 years”, “NES; duration of residence 10–19 years”, “NES; duration of residence \geq 20 years”, and “native-born”. The cut points for duration of residence were chosen to: (1) reflect the empirical evidence suggesting that after 10 years an initial health advantage is lost (Gee et al., 2004); (2) ensure sufficient statistical power and allow reasonable estimates of uncertainty; (3) allow for the adoption of host country lifestyle.

Consistent with other studies that examined disability, we included the following covariates and mediating variables. The main time invariant control variable was

Age at wave 1 (henceforth age). English language proficiency, household equivalised income, current marital status, level of education, employment status, physical activity, smoking, and drinking were the main time-varying covariates used in the analysis. The mediating role of the time-varying covariates in the association between nativity/ duration of residence and long-term disability was tested by repeating the analysis by including and excluding these variables from the analysis.

Statistical analysis

Cox regression model with time-varying covariates, which is a generalization of Cox regression with static explanatory variables, was used in this study to examine whether the time to incidence of long-term disability varies by nativity or by duration of residence, after controlling for other confounding factors. Explanatory variables such as income, marital status, and age, which are likely to vary over time, can alter the risk of disability. The Cox regression model with time-varying covariates takes into account the time-varying nature of these explanatory variable. We proceeded step by step using four models (model 1, 2, 3 and 4) to investigate the association between nativity status and the incidence of long-term disability, and between duration of residence and the incidence of long-term disability. Analysis was done separately for men and women. Statistical analyses were carried out by using Statistical Analysis Software (SAS).

Results

The characteristics of the study respondents at the baseline (wave 1) are shown in Table 1, while Table 2 shows the number and percent of men and women who have experienced long-term disability, by nativity status, and by duration of residence in Australia.

The results of Cox regression model with time-varying covariates for men and women with nativity status as the main exposure variable are shown in Tables 3 and 4, and with duration of residence as the main exposure variable are shown in Tables 5 and 6. Results from Model 1 (Table 3) showed that after adjusting for age, the risk of developing long-term disability for FB men from ES countries (HR = 0.92 and CI = 0.78 to 1.09) and for the FB men from NES countries (OR = 0.97 and CI = 0.82 to 1.15) was not statistically different from the NB men. This result did not change after adjusting for English language proficiency (model II, Tables 3) and socioeconomic covariates (model III, Tables 3) and health behaviour variables (model IV, Tables 3). Similar results were seen for women (Table 4).

We now turn to investigate the association between nativity, duration of residence and the development of disability. We found that that after controlling for age, foreign-born men from both ES countries (HR is 0.53; 95% CI 0.28 to 0.99) and NES countries (HR is 0.53%; 95% CI 0.33 to 0.86) have 47% lower risk of instantaneous long-term disability as compared to the NB men, when their duration of residence is less than 10 years in Australia (model I, Table 5). After 10 or more years of

Table 1 Wave 1 characteristics (frequency and column per cent) of the study respondents by their nativity status

Characteristic	Nativity status							
	All				FB from NES countries			
	Native-born		FB from ES countries		Male		Female	
	Male	Female	Male	Female	Male	Female	Male	Female
<i>Duration of residence in Australia</i>								
Australia	3339(75.99)	3957(77.03)	3339(100.0)	3957(100.0)	0(0.00)	0(0.00)	0(0.00)	0(0.00)
< 10 years	203(4.62)	247(4.81)	0(0.00)	0(0.00)	70(13.75)	60(12.05)	133(24.36)	187(27.42)
10–19 years	267(6.08)	319(6.21)	0(0.00)	0(0.00)	117(22.99)	108(21.69)	150(27.47)	211(30.94)
≥ 20 years	585(13.31)	614(11.95)	0(0.00)	0(0.00)	322(63.26)	330(66.27)	263(48.17)	284(41.64)
<i>Age group</i>								
15–29 years	1111(25.28)	1260(24.53)	937(28.06)	1055(26.66)	60(11.79)	55(11.04)	114(20.88)	150(21.99)
30–44 years	1529(34.80)	1793(34.90)	1177(35.25)	1372(34.67)	172(33.79)	170(34.14)	180(32.97)	251(36.80)
45–59 years	1052(23.94)	1177(22.91)	741(22.19)	855(21.61)	168(33.01)	143(28.72)	143(26.19)	179(26.25)
≥ 60 years	702(15.98)	907(17.66)	484(14.50)	675(17.06)	109(21.42)	130(26.10)	109(19.96)	102(14.96)
<i>English language ability</i>								
Proficient	3948(89.89)	4574(89.06)	3249(97.36)	3865(97.70)	494(97.05)	486(97.59)	205(37.55)	223(32.70)
Good	405(9.22)	484(9.42)	88(2.64)	89(2.25)	15(2.95)	12(2.41)	302(55.31)	383(56.16)
Not good	39(0.89)	78(1.52)	0(0.00)	2(0.05)	0(0.00)	0(0.00)	39(7.14)	76(11.14)
<i>Equalised income</i>								
≤ 20,000	1332(30.31)	1859(36.19)	980(29.35)	1385(35.00)	133(26.13)	164(32.93)	219(40.11)	310(45.46)
(20,000–40,000]	2131(48.50)	2348(45.71)	1666(49.90)	1845(46.63)	232(45.58)	224(44.98)	233(42.67)	279(40.91)
(40,000–60,000]	707(16.09)	730(14.21)	540(16.17)	581(14.68)	101(19.84)	79(15.86)	66(12.09)	70(10.26)
> 60,000	224(5.10)	200(3.89)	153(4.58)	146(3.69)	43(8.45)	31(6.23)	28(5.13)	23(3.37)
<i>Current marital status</i>								
Married/in De facto	2934(66.82)	3343(65.13)	2141(64.18)	2505(63.37)	395(77.60)	366(73.49)	398(72.89)	472(69.21)
Separated/Widowed	321(7.31)	778(15.16)	254(7.61)	580(14.67)	37(7.27)	87(17.47)	30(5.50)	111(16.28)

Table 1 (continued)

Characteristic	All						Nativity status			
	Male		Female		Native-born		FB from ES countries		FB from NES countries	
					Male	Female	Male	Female	Male	Female
Never married	1136(25.87)	1012(19.72)	941(28.21)	868(21.96)	77(15.13)	45(9.04)	118(21.61)	99(14.52)		
<i>Education level</i>										
<12 years of schooling	1400(31.87)	2341(45.59)	1141(34.18)	1902(48.08)	150(29.47)	183(36.75)	109(19.96)	256(37.59)		
12 years of schooling	607(13.82)	820(15.97)	448(13.42)	580(14.66)	53(10.41)	84(16.87)	106(19.41)	156(22.91)		
Diploma/certificate	1523(34.67)	938(18.27)	1165(34.90)	707(17.87)	188(36.94)	122(24.50)	170(31.14)	109(16.01)		
Had University education	863(19.65)	1036(20.18)	584(17.50)	767(19.39)	118(23.18)	109(21.89)	161(29.49)	160(23.50)		
<i>Employment status</i>										
Employed	3360(76.47)	3039(59.16)	2613(78.26)	2413(60.98)	370(72.69)	278(55.82)	377(69.05)	348(51.03)		
Unemployed	202(4.60)	185(3.60)	142(4.25)	132(3.34)	24(4.72)	21(4.22)	36(6.59)	32(4.69)		
Not in the labour force	832(18.94)	1913(37.24)	584(17.49)	1412(35.68)	115(22.59)	199(39.96)	133(24.36)	302(44.28)		
<i>Smoke</i>										
Never smoked	1948(46.77)	2787(57.01)	1547(48.57)	2126(55.99)	181(37.63)	241(50.42)	220(44.09)	420(68.40)		
Former smoker	1205(28.93)	1145(23.42)	851(26.72)	880(23.18)	184(38.25)	156(32.64)	170(34.07)	109(17.75)		
Current smoker	1012(24.30)	957(19.58)	787(24.71)	791(20.83)	116(24.12)	81(16.95)	109(21.84)	85(13.84)		
<i>Drink</i>										
Never drunk	271(6.49)	535(10.93)	196(6.14)	332(8.73)	5(1.04)	24(5.02)	70(14.00)	179(29.25)		
Former drinker	168(4.03)	211(4.31)	117(3.66)	157(4.13)	22(4.57)	23(4.81)	29(5.80)	31(5.07)		
Current drinker	3735(89.48)	4149(84.76)	2880(90.20)	3316(87.15)	454(94.39)	431(90.17)	401(80.20)	402(65.69)		
<i>Physical activity</i>										
Not at all	317(7.60)	522(10.67)	220(6.89)	368(9.68)	45(9.36)	56(11.72)	52(10.48)	98(15.99)		
<3 times per week	1466(35.14)	1992(40.70)	1100(34.43)	1564(41.13)	161(33.47)	180(37.66)	205(41.33)	248(40.46)		

Table 1 (continued)

Characteristic	Nativity status							
	All		Native-born		FB from ES countries		FB from NES countries	
	Male	Female	Male	Female	Male	Female	Male	Female
≥ times per week	2389(57.26)	2380(48.63)	1875(58.69)	1871(49.20)	275(57.17)	242(50.63)	239(48.19)	267(43.56)
Total	4394(100)	5137(100)	3339(100)	3957(100)	509(100)	498(100)	546(100)	682(100)

Sum of column elements by each characteristic need not be equal to the total sample size, due to missing values
 Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries.

Table 2 Incidence of disability during the study period

Characteristic	Total number of respondents	Number developed disability during study period	Percent developed disability during study period	Log-rank test* (<i>p</i> value)
<i>Nativity status</i>				
<i>All</i>				
Australia	7296	2163	29.65	0.167
ES countries	1007	324	32.17	
NES countries	1228	337	27.44	
<i>Male</i>				
Australia	3339	943	28.24	0.569
ES countries	509	154	30.26	
NES countries	546	150	27.47	
<i>Female</i>				
Australia	3957	1220	30.83	0.517
ES countries	498	170	34.14	
NES countries	682	187	27.42	
<i>Duration of residence in Australia</i>				
<i>All</i>				
Australia	7296	2163	29.65	<0.0001
ES < 10 years	130	25	19.23	
ES 10–19 years	225	52	23.11	
ES ≥ 20 years	652	247	37.88	
NES < 10 years	320	42	13.13	
NES 10–19 years	361	77	21.33	
NES ≥ 20 years	547	218	39.85	
<i>Male</i>				
Australia	3339	943	28.24	<0.0001
ES < 10 years	70	10	14.29	
ES 10–19 years	117	28	23.93	
ES ≥ 20 years	322	116	36.02	
NES < 10 years	133	17	12.78	
NES 10–19 years	150	29	19.33	
NES ≥ 20 years	263	104	39.54	
<i>Female</i>				
Australia	3957	1220	30.83	<0.001
ES < 10 years	60	15	25	
ES 10–19 years	108	24	22.22	
ES ≥ 20 years	330	131	39.7	
NES < 10 years	187	25	13.37	
NES 10–19 years	211	48	22.75	
NES ≥ years	284	114	40.14	
Total	9531	2824	29.63	

*log-rank tests were performed to test whether the pattern of incidence of disability varies by nativity status and by duration of residence in Australia, separately for men and women, and combining men and women. Results were presented in the form of *p*-values. Null hypothesis is no difference in the pattern of incidence of disability by the considered characteristic

Table 2 (continued)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries

Duration of residence is categorised into less than 10 years, 10–19 years, and greater than or equal 20 years in Australia, and combined with the nativity status variable described above

residence, however, the risk of developing long-term disability for foreign-born men from English-speaking and non-English speaking countries was not significantly different from those of native-born men. Even after controlling for English language proficiency these conclusions remained the same (model II, Table 5). However, after further adjusting for the socio-economic factors, immigrant men from English speaking countries with any duration of residence were not significantly different from Native-born men in the risk of developing long-term disability (model III, Table 5). Further controlling for health behaviour variables did not alter our above conclusions (model IV, Table 5).

Model I result from Table 6 showed that after controlling for age, foreign-born women from ES countries were not statistically different from the NB women in terms of the risk of long-term disability, irrespective of their duration of residence. However, foreign-born women from non-English speaking countries have 45% lower risk of developing long-term disability as compared to the NB women, when their duration of residence is less than 10 years in Australia (HR is 0.55; 95% CI is 0.37 to 0.83). After 10 or more years of residence, however, their risk of developing long-term disability was not significantly different from those of native-born women. The results did not change for immigrant women from ES countries even after controlling for English language proficiency (model II, Table 6). However, additionally adjusting for the socio-economic factors (model III, Table 6) their risk of developing long-term disability after 20 or more years of duration of residence in Australia was found to be 25% higher (95% CI is 1.04 to 1.50) as compared to NB women. Further controlling for health behaviour variables did not alter our above conclusions (model IV, Table 6). On the other hand, after additionally adjusting for English language proficiency (model II, Table 6), foreign-born women from non-English speaking countries had lower risk of developing the long-term disability when their duration of residence was 10 to 19 years (HR 0.63; 95% CI is (0.45 to 0.89)). This conclusion remained the same even after controlling for socio-economic factors and health behaviour variables considered in this study, despite minor differences in the magnitude of effect (models III and IV, Table 6).

Discussion

Using a nationally representative panel data set, in this study, we have examined the longitudinal association between nativity, duration of residence and the onset of disability among migrants and non-migrants in Australia. We also examined the mechanisms underlying the association between duration of residence and disability. First, contrary to the studies (Cabieses et al., 2012; Newbold & Simone, 2015) that

Table 3 Cox regression results with time-varying covariates for men, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability with nativity status as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
<i>Nativity status</i>								
ES Countries	0.92	(0.78, 1.09)	0.92	(0.78, 1.10)	0.91	(0.77, 1.08)	0.88	(0.73, 1.05)
NES Countries	0.97	(0.82, 1.15)	1.07	(0.85, 1.34)	0.98	(0.78, 1.23)	0.94	(0.74, 1.20)
<i>NB (R)</i>								
<i>Age group</i>								
15–29 years	0.36**	(0.29, 0.46)	0.37**	(0.29, 0.46)	0.62**	(0.47, 0.82)	0.70*	(0.53, 0.94)
30–44 years	0.38**	(0.33, 0.44)	0.39**	(0.33, 0.45)	0.72**	(0.59, 0.87)	0.74**	(0.61, 0.91)
45–59 years	0.45**	(0.39, 0.51)	0.45**	(0.39, 0.51)	0.88	(0.74, 1.04)	0.85	(0.71, 1.02)
≥ 60 (R)								
<i>English language proficiency</i>								
Good			0.78	(0.59, 1.02)	0.71*	(0.54, 0.94)	0.74*	(0.55, 1.00)
Not good			1.35	(0.77, 2.37)	0.83	(0.47, 1.47)	0.96	(0.49, 1.86)
<i>Proficient (R)</i>								
<i>Household equivalised income</i>								
≤ 20,000					6.53**	(5.23, 8.15)	6.08**	(4.83, 7.65)
(20,000–40,000					3.27**	(2.69, 3.98)	3.21**	(2.63, 3.92)
(40,000–60,000					1.64**	(1.33, 2.03)	1.60**	(1.29, 2.00)
≥ 60,000 (R)								
<i>Marital status</i>								
Separated/Widowed					0.93	(0.79, 1.10)	0.93	(0.78, 1.11)
Never married					0.95	(0.79, 1.14)	0.98	(0.81, 1.19)
<i>Married (R)</i>								
<i>Level of education</i>								
<12 years of schooling			1.18	(0.99, 1.41)	1.13	(0.94, 1.36)		

Table 3 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
12 years of schooling			0.99	(0.79, 1.24)	1.02	(0.80, 1.28)		
Diploma/certificate				1.00		1.00		
Had University education (R)								(0.84, 1.18)
<i>Employment status</i>								
Employed					0.95	(0.66, 1.37)	1.05	(0.72, 1.52)
Not working					1.41**	(1.19, 1.68)	1.34**	(1.12, 1.60)
Unemployed (R)								
<i>Smoke</i>								
Former smoker							1.15*	(1.00, 1.32)
Current smoke							1.17	(1.00, 1.39)
Never smoked (R)								
<i>Drink</i>								
Former drinker							0.91	(0.68, 1.23)
Current drinker							0.80	(0.64, 1.00)
Never drunk (R)								
<i>Physical activity</i>								
< 3 times per							0.78**	(0.64, 0.93)
≥ 3 times per							0.69**	(0.58, 0.82)

Table 3 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Not at all (R)								
<i>n</i>		4381		4381		4378		3874
$-2\log(L)$		19,857.626		19,852.317		19,307.443		17,810.115
<i>AIC</i>		19,867.626		19,866.317		19,341.443		17,856.115

*Indicate $p < 0.05$; ** indicate $p < 0.01$; AIC indicates Akaike Information Criterion (lower the AIC value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries

Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

suggest that migrants have better health outcomes than the foreign-born, we found no variation in the development of long-term disability by nativity status. Dey and Lucas (2006) found little variation in reporting having Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) limitations between foreign-born individuals, and US-born. However, the result that there is no overall difference of risks of disability for the immigrants and the native-born does not mean that there is no “healthy migration effect”. The result could well be an average effect of healthy migration selection combined with later erosion of immigrants’ health. While the healthy immigrant effect can be lost in as few as 5 years (or less) following arrival (e.g. see papers based on studies based on Longitudinal study of Immigrants in Canada which have noted significant declines in health within two years of arrival (De Maio, 2010; Newbold, 2010, the finding that migrants in short-stay duration (less than 10 years) have reduced risks of disability might be an indication of such healthy migration selection. The current paper looks at disability from age 15 and over. However, most disabilities, and more significant ones that can affect activities of daily living, develop much later in life. In the aging literature, the convergence of risks of disability might be a result of the aging process. Thus, a plausible alternative explanation for this finding would be, migration selection occurred in the early stage of migration when migrants are in general at young or middle age, but over more than 20 years, everyone has much greater risks of having disability, and aging becomes the “great equalizer”. To test this, we restricted our sample to 50 and over age group (results shown in Appendix). While the nativity results remained unchanged, restricting our sample to 50 and over age group showed no evidence of differences in the risk of developing long-term disability by duration of residence for immigrant men and women from both ES countries and NES countries compared to NB men and women respectively (Model 1, Tables 7, 8, 9, 10). Having said that, we need to be extremely cautious while drawing conclusions based on the sample 50 and over due to small sample size in some of the cells.

Another possible explanation for the convergence of the long-term disability of immigrants with the native-born Australians is the stress associated with settling down process (de la Rosa, 2002) and/or experiences of discrimination which FB individual face more than the native-born (Markus, 2015; Paradies, 2006). Previous research using longitudinal survey data demonstrated that perceptions of discrimination impair immigrants’ mental and physical health and that the effect of perceived discrimination on physical health is completely mediated by its effect on mental health (Schunck et al., 2015). The lack of difference in developing long-term disability among immigrant women from ES countries may provide evidence that positive selection on health is operating less for immigrant women from ES countries than for all other immigrant groups. Markides et al. (2007) have noted that health selection plays a lesser role for immigrant women than immigrant men for immigration.

Second, for foreign-born women from non-English speaking countries, English language proficiency mediated the relationship between duration of residence and disability. Good English proficiency seems to offset the disadvantage of poor health associated with longer duration of stay for women from NES countries. English language proficiency may mediate the health of women immigrants from NES countries via improving access to health services, improving labour market outcome

Table 4 Cox regression results with time-varying covariates for women, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability with nativity status as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
<i>Nativity status</i>								
ES Countries	1.01	(0.86, 1.19)	1.02	(0.86, 1.19)	1.13	(0.96, 1.32)	1.14	(0.96, 1.35)
NES Countries	0.94	(0.81, 1.10)	0.75*	(0.60, 0.94)	0.80*	(0.64, 1.00)	0.82	(0.65, 1.04)
NB (R)								
<i>Age group</i>								
15–29 years	0.43**	(0.35, 0.52)	0.43**	(0.35, 0.53)	0.82	(0.65, 1.05)	0.84	(0.65, 1.08)
30–44 years	0.40**	(0.35, 0.46)	0.40**	(0.35, 0.46)	0.80**	(0.68, 0.93)	0.79**	(0.67, 0.94)
45–59 years	0.50**	(0.45, 0.57)	0.50**	(0.45, 0.57)	1.08	(0.93, 1.24)	1.05	(0.90, 1.22)
≥ 60 years								
<i>English language proficiency</i>								
Good			1.18	(0.93, 1.50)	0.99	(0.78, 1.26)	0.91	(0.70, 1.18)
Not good			2.67**	(1.82, 3.92)	1.44	(0.98, 2.12)	1.61	(0.99, 2.61)
Proficient (R)								
<i>Household equivalised income</i>								
≤ 20,000					6.11**	(4.93, 7.59)	5.92**	(4.72, 7.41)
(20,000–40,000					3.00**	(2.46, 3.65)	2.95**	(2.40, 3.62)
(40,000–60,000					1.72**	(1.39, 2.12)	1.70**	(1.37, 2.12)
≥ 60,000 (R)								
<i>Marital status</i>								
Separated/Widowed					1.01	(0.90, 1.14)	1.00	(0.89, 1.13)
Never married					0.97	(0.80, 1.17)	0.97	(0.79, 1.19)
Married (R)								

Table 4 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
<i>Level of education</i>								
<12 years of schooling			1.34**	(1.15, 1.57)	1.35**	(1.14, 1.58)		
12 years of schooling				1.10	(0.90, 1.33)	1.13	(0.92, 1.38)	
Diploma/certificate				0.95	(0.80, 1.12)	0.94	(0.79, 1.12)	
Had University education (R)								
<i>Employment status</i>								
Employed					0.97	(0.66, 1.41)	0.93	(0.62, 1.38)
Not working					1.39**	(1.22, 1.59)	1.35**	(1.18, 1.56)
Unemployed (R)								
<i>Smoke</i>								
Former smoker								
Current smoke						1.10		(1.08, 1.47)
Never smoked (R)								
<i>Drink</i>								
Former drinker							1.08	(0.86, 1.36)
Current drinker							0.85*	(0.73, 1.00)
Never drunk (R)								
<i>Physical activity</i>								
<3 times per							0.77**	(0.66, 0.90)
≥3 times per							0.72**	(0.62, 0.84)
Not at all (R)								
<i>n</i>		5120		5120		5113		4560
<i>-2log(L)</i>		25,644.081		25,622.351		24,942.052		22,572.801

Table 4 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
AIC		25,654.081		25,636.351		24,976.052		22,618.801

*Indicate $p < 0.05$; ** indicate $p < 0.01$; AIC indicates Akaike Information Criterion (lower the AIC value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries

Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

and by reducing acculturative stress. First, while knowledge of language increases the independence of immigrant women (Setia et al., 2011a), language barriers can contribute to poorer health outcomes by reduced communication between patients and providers and access to health care. Second, English language proficiency can indirectly affect health via limited employment opportunities (Grondin, 2007). For immigrant women from NES countries, limited English language proficiency will put them at a greater disadvantage in terms of economic opportunities. Previous research has shown that language skills are linked to economic success (Grondin, 2007). Third, limited language proficiency may magnify acculturative stress, which will have adverse effect on their health (Pudarcic et al., 2003).

Third, for both men and women from ES countries, SES factors were key mediators. On the one hand, controlling for all the SES variables eliminated the relative advantage of immigrant men from English-speaking countries in developing long-term disability so that they were no longer significantly different from native-born men. On the other hand, controlling for socio-economic factors increased the gap between immigrant women from ES countries and the NB women in developing long-term disability in a way that they became disadvantaged with an increased risk of developing long-term disability as compared to native-born women. These findings also suggest that explanatory mechanisms for long-term disability might be different for different migrant groups and between gender, suggesting complex relationship between mediators and nativity/duration of residence relationship. They also point to further detailed analysis to explain gender differential role of SES factors in explaining immigrant health advantage.

There are some limitations in this study. First, the measures of disability are self-reported, which may not accurately reflect an individual's actual physical ability (Siordia, 2014; Siordia, 2015). Future research should obtain objective measures of disability assessment. Second, by grouping all immigrants (e.g., skilled migrants and humanitarian migrants) into one group, this study failed to capture the heterogeneity of immigrants. However, this grouping was necessary to get stable results. Moreover, the question on immigrant visa categories, such as regular migrants (e.g., employment visa, student visa, family visa, skilled visa, and family visa) and humanitarian migrants (e.g., refugees and asylum seekers) was not asked in all the waves. We acknowledge that the disability patterns among skilled migrants may be different from those coming on humanitarian grounds. Moreover, refugees/humanitarian migrants made up of only 0.03 of the total sample in wave 4 when the information on migrant category was first asked, hence, leaving them out from our study would not have made a difference to our results. Similarly, this paper makes very broad categories of immigrants based on whether they belong to English speaking and non-English speaking countries. However, this categorisation was important to compare our results with previous research using similar categorisation. We recommend using Multi-Agency Data Integration Project (MADIP) data for future research, particularly for the impact of VISA type on disability. MADIP is a longitudinal data asset combining information from various data sets for Australian Population (Australian Bureau of Statistics, 2023).

Third, our analyses may be affected by selection bias if those who dropped from the study reported substantially more or less disability. In our study, FB

Table 5 Cox regression results with time-varying covariates for men, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability with nativity status combined with duration of residence as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
<i>Duration of residence</i>								
ES < 10	0.53*	(0.28, 0.99)	0.53*	(0.29, 1.00)	0.61	(0.33, 1.15)	0.63	(0.32, 1.27)
ES 10 to 19	0.81	(0.56, 1.18)	0.81	(0.56, 1.18)	0.92	(0.63, 1.35)	0.92	(0.62, 1.36)
ES ≥ 20	1.03	(0.85, 1.26)	1.03	(0.85, 1.26)	0.95	(0.78, 1.16)	0.90	(0.73, 1.10)
NES < 10	0.53**	(0.33, 0.86)	0.56*	(0.33, 0.95)	0.53*	(0.31, 0.91)	0.46**	(0.25, 0.82)
NES 10 to 19	0.81	(0.56, 1.18)	0.81	(0.53, 1.24)	0.85	(0.55, 1.31)	0.80	(0.51, 1.26)
NES ≥ 20	1.20	(0.98, 1.48)	1.24	(0.98, 1.56)	1.08	(0.85, 1.37)	1.05	(0.82, 1.34)
<i>Australia (R)</i>								
<i>Age group</i>								
15–29 years	0.39**	(0.31, 0.49)	0.40**	(0.31, 0.50)	0.66**	(0.50, 0.87)	0.74*	(0.55, 0.99)
30–44 years	0.40**	(0.35, 0.47)	0.41**	(0.35, 0.47)	0.74**	(0.61, 0.90)	0.76**	(0.62, 0.93)
45–59 years	0.47**	(0.41, 0.53)	0.47**	(0.41, 0.54)	0.89	(0.75, 1.06)	0.86	(0.72, 1.04)
≥ 60 (R)								
<i>English language proficiency</i>								
Good			0.88	(0.67, 1.16)	0.80	(0.60, 1.06)	0.84	(0.63, 1.13)
Not good			1.60	(0.90, 2.84)	0.95	(0.53, 1.71)	1.12	(0.57, 2.20)
<i>Proficient (R)</i>								
<i>Household equivalised income</i>								
≤ 20,000					6.51**	(5.21, 8.13)	6.07**	(4.82, 7.64)
(20,000–40,000)					3.26**	(2.68, 3.97)	3.20**	(2.62, 3.92)
(40,000–60,000)					1.64**	(1.32, 2.02)	1.60**	(1.29, 1.99)
≥ 60,000 (R)								
<i>Marital status</i>								
Separated/Widowed					0.93	(0.79, 1.11)	0.94	(0.78, 1.12)

Table 5 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
Never married					0.94	(0.78, 1.14)	0.98	(0.80, 1.19)
Married (R)								
<i>Level of education</i>								
< 12 years of schooling		1.16	(0.97, 1.38)	1.11	(0.92, 1.33)			
12 years of schooling		0.96	(0.76, 1.21)	0.99	(0.79, 1.26)			
Diploma/certificate		0.98	(0.83, 1.16)	0.98	(0.82, 1.16)			
Had University education (R)								
<i>Employment status</i>								
Employed			0.95	(0.66, 1.37)	1.05	(0.72, 1.52)		
Not working			1.41**	(1.19, 1.68)	1.34**	(1.12, 1.59)		
Unemployed (R)								
<i>Smoke</i>								
Former smoker					1.14	(1.00, 1.31)		
Current smoker					1.16	(0.99, 1.37)		
Never smoked (R)								
<i>Drink</i>								
Former drinker					0.90	(0.66, 1.21)		
Current drinker					0.77*	(0.62, 0.97)		
Never drinker (R)								
<i>Physical activity</i>								
< 3 times per week					0.78*	(0.65, 0.95)		
≥ 3 times per week					0.69**	(0.58, 0.83)		
Not at all (R)								

Table 5 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
<i>n</i>		4381		4381		4378		3874
$-2\log(L)$		19,839.758		19,835.864		19,297.605		17,800.000
<i>AIC</i>		19,857.758		19,857.864		19,339.605		17,854.000

*Indicate $p < 0.05$; ** indicate $p < 0.01$; AIC indicates Akaike Information Criterion (lower the AIC value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries. Duration of residence is categorised into less than 10 years, 10–19 years, and greater than or equal 20 years in Australia, and combined with the nativity status variable described above

Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

Table 6 Cox regression results with time-varying covariates for women, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of considerable disability by nativity status combined with duration of residence as the main exposure variable

Characteristic	Model I			Model II			Model III			Model IV		
	Hazard ratio	95% CI		Hazard ratio	95% CI		Hazard ratio	95% CI		Hazard ratio	95% CI	
<i>Duration of residence</i>												
ES < 10	0.93	(0.56, 1.56)		0.92	(0.55, 1.52)		0.96	(0.57, 1.60)		1.09	(0.65, 1.83)	
ES 10 to 19	0.72	(0.48, 1.08)		0.72	(0.48, 1.08)		0.82	(0.54, 1.22)		0.82	(0.54, 1.25)	
ES ≥ 20	1.12	(0.93, 1.34)		1.13	(0.94, 1.35)		1.25*	(1.04, 1.50)		1.24*	(1.03, 1.50)	
NES < 10	0.55**	(0.37, 0.83)		0.36**	(0.23, 0.57)		0.40**	(0.25, 0.62)		0.34**	(0.20, 0.58)	
NES 10 to 19	0.87	(0.65, 1.17)		0.63**	(0.45, 0.89)		0.68*	(0.49, 0.96)		0.66*	(0.46, 0.95)	
NES ≥ 20	1.16	(0.95, 1.41)		0.92	(0.73, 1.17)		0.96	(0.75, 1.22)		1.05	(0.81, 1.35)	
<i>Australia (R)</i>												
<i>Age group</i>												
15–29 years	0.45**	(0.36, 0.55)		0.45**	(0.37, 0.56)		0.87	(0.69, 1.11)		0.88	(0.69, 1.14)	
30–44 years	0.42**	(0.37, 0.48)		0.42**	(0.37, 0.49)		0.84*	(0.72, 0.98)		0.84*	(0.71, 0.99)	
45–59 years	0.52**	(0.46, 0.59)		0.52**	(0.46, 0.59)		1.11	(0.97, 1.29)		1.08	(0.93, 1.26)	
≥ 60 (R)												
<i>English language proficiency</i>												
Good				1.28*	(1.01, 1.62)		1.06	(0.83, 1.34)		0.98	(0.76, 1.27)	
Not good				3.21**	(2.18, 4.73)		1.67**	(1.13, 2.47)		1.95**	(1.20, 3.17)	
<i>Proficient (R)</i>												
<i>Household equivalised income</i>												
≤ 20,000							6.20**	(4.99, 7.70)		6.04**	(4.82, 7.57)	
(20,000–40,0							3.01**	(2.47, 3.66)		2.96**	(2.41, 3.64)	
(40,000–60,0							1.72**	(1.39, 2.12)		1.70**	(1.37, 2.12)	
≥ 60,000 (R)												
<i>Marital status</i>												

Table 6 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
Separated/Widowed					1.00	(0.89, 1.13)	0.99	(0.88, 1.12)
Never married					0.96	(0.79, 1.17)	0.97	(0.79, 1.18)
Married (R)								
<i>Level of education</i>								
<12 years of schooling				1.29**	(1.11, 1.51)	1.29**	(1.10, 1.52)	
12 years of schooling				1.08	(0.89, 1.31)	1.11	(0.91, 1.36)	
Diploma/certificate				0.93	(0.78, 1.10)	0.92	(0.77, 1.10)	
Had University education (R)								
<i>Employment status</i>								
Employed					0.98	(0.67, 1.44)	0.94	(0.63, 1.40)
Not working					1.41**	(1.23, 1.61)	1.35***	(1.18, 1.55)
Unemployed (R)								
<i>Smoke</i>								
Former smoker							1.09	(0.96, 1.23)
Current smoker							1.25***	(1.07, 1.45)
Never smoked (R)								
<i>Drink</i>								
Former drinker							1.04	(0.83, 1.31)
Current drinker							0.83*	(0.71, 0.97)
Never drunk (R)								
<i>Physical activity</i>								
<3 times per week							0.77**	(0.66, 0.89)
≥ 3 times pe							0.72**	(0.62, 0.84)

Table 6 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
Not at all (R)								
<i>n</i>		5120		5120		5113		4560
$-2\log(L)$		25,627.011		25,597.592		24,920.308		22,547.846
<i>AIC</i>		25,645.011		25,619.592		24,962.308		22,601.846

* Indicate $p < 0.05$; ** indicate $p < 0.01$; AIC indicates Akaike Information Criterion (lower the AIC value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries. Duration of residence is categorised into less than 10 years, 10–19 years, and greater than or equal 20 years in Australia, and combined with the nativity status variable described above

Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

from both ES countries and NESC were more likely to drop out than NB. If those who dropped out from the study were more likely to report disability, then the true population relationship between nativity and health would be stronger than found in this study. However, the nativity-disability relationship in these “drop-outs” would need to be very different to the “stay-ins” to change our conclusions. Additionally, there is no way to check the magnitude and direction of this bias with HILDA data, in its current form, until an additional information is collected on whether disability is the cause for dropout. This is an important question for future longitudinal studies. Fourth, the analysis only includes up to wave 13 while data from HILDA is now available up to wave 21. We recommend replicating the work with more recent data as the composition of migration intake as well as the prevalence of disability may have changed.

Notwithstanding limitations, this study has several strengths. This study is the first longitudinal study to our knowledge to investigate how the risk of long-term disability varies by nativity, how does duration of residence matter and what mechanisms cause them. While the complexity of results indicates much work remains to be done to understand the process by which nativity differences with longer duration of residence exist, they deserve policy attention. With an increasing proportion of foreign-born people and increasingly diversified ageing migrant population, it is critical that health intervention policy responses be directed to long-term immigrants in the host country.

Appendix

See Tables [7](#), [8](#), [9](#) and [10](#).

Table 7 Cox regression results with time-varying covariates for men ages 50+, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability with Nativity as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
<i>Nativity</i>								
ES Countries	0.86	(0.70, 1.07)	0.86	(0.70, 1.07)	0.90	(0.73, 1.12)	0.89	(0.71, 1.11)
NES Countries	1.06	(0.85, 1.32)	1.09	(0.80, 1.47)	0.94	(0.69, 1.29)	0.94	(0.68, 1.30)
<i>NB (R)</i>								
<i>Age group</i>								
45–59 years	2.41**	(1.94, 3.00)	2.42**	(1.95, 3.01)	2.72**	(2.15, 3.45)	2.98**	(2.31, 3.83)
≥ 60 (R)								
<i>English language proficiency</i>								
Good			0.92	(0.62, 1.37)	0.96	(0.64, 1.44)	0.92	(0.60, 1.41)
Not good			1.21	(0.60, 2.47)	0.86	(0.42, 1.75)	1.11	(0.52, 2.40)
<i>Proficient (R)</i>								
<i>Household equivalised income</i>								
≤ 20,000					3.98**	(2.92, 5.42)	3.96**	(2.87, 5.46)
(20,000–40,000					2.01**	(1.50, 2.70)	2.07**	(1.53, 2.79)
(40,000–60,000					1.54**	(1.11, 2.13)	1.56**	(1.12, 2.17)
≥ 60,000 (R)								
<i>Marital status</i>								
Separated/Widowed					0.86	(0.69, 1.06)	0.87	(0.69, 1.09)
Never married					0.79	(0.54, 1.15)	0.87	(0.58, 1.31)
<i>Married (R)</i>								
<i>Level of education</i>								
< 12 years of schooling			1.27	(0.98, 1.65)	1.18	(0.91, 1.54)		
12 years of schooling			1.16	(0.81, 1.68)	1.17	(0.81, 1.70)		
Diploma/certificate			1.24	(0.97, 1.60)	1.16	(0.90, 1.51)		

Table 7 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Had University education (R)								
<i>Employment status</i>								
Employed			0.96	(0.52, 1.78)	0.88	(0.47, 1.65)		
Not working			1.12	(0.92, 1.37)	1.10	(0.90, 1.36)		
Unemployed (R)								
<i>Smoke</i>								
Former smoker					1.17	(0.98, 1.41)		
Current smoke					1.14	(0.87, 1.50)		
Never smoked (R)								
<i>Drink</i>								
Former drinker					0.88	(0.59, 1.31)		
Current drinker					0.78	(0.58, 1.05)		
Never drunk (R)								
<i>Physical activity</i>								
< 3 times per					0.94	(0.74, 1.20)		
≥ 3 times per					0.77*	(0.61, 0.97)		
Not at all (R)								
<i>n</i>		1325		1325		1324		1227
-2log(L)		8759.23		8758.64		8587.46		7980.27
AIC		8765.23		8768.64		8617.46		8022.27

* Indicate $p < 0.05$; ** indicate $p < 0.01$; AIC indicates Akaike Information Criterion (lower the AIC value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries

Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

Table 8 Cox regression results with time-varying covariates for women aged 50+, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability with Nativity as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
<i>Nativity</i>								
ES Countries	0.95	(0.77, 1.16)	0.95	(0.77, 1.16)	1.03	(0.84, 1.26)	1.03	(0.83, 1.28)
NES Countries	0.97	(0.79, 1.19)	0.68*	(0.50, 0.93)	0.72*	(0.53, 0.97)	0.69*	(0.49, 0.96)
<i>NB (R)</i>								
<i>Age group</i>								
45–59 years	3.09**	(2.58, 3.71)	3.05**	(2.54, 3.66)	3.97**	(3.26, 4.83)	3.89**	(3.17, 4.78)
≥ 60 years								
<i>English language proficiency</i>								
Good			1.41	(0.99, 2.01)	1.18	(0.83, 1.67)	1.12	(0.76, 1.65)
Not good			2.81**	(1.75, 4.53)	1.78*	(1.10, 2.88)	2.61**	(1.46, 4.67)
<i>Proficient (R)</i>								
<i>Household equivalised income</i>								
≤ 20,000					3.52**	(2.58, 4.80)	3.54**	(2.56, 4.88)
(20,000–40,000					1.78**	(1.31, 2.41)	1.75**	(1.27, 2.40)
(40,000–60,000					1.53*	(1.10, 2.13)	1.58**	(1.12, 2.22)
≥ 60,000 (R)								
<i>Marital status</i>								
Separated/Widowed					1.04	(0.90, 1.20)	1.06	(0.91, 1.23)
Never married					0.95	(0.62, 1.44)	0.93	(0.60, 1.43)
Married (R)								
<i>Level of education</i>								
< 12 years of schooling			1.11	(0.88, 1.40)	1.10	(0.86, 1.41)		
12 years of schooling				1.14	(0.83, 1.58)	1.16	(0.83, 1.63)	
Diploma/certificate				1.00	(0.76, 1.31)	1.01	(0.76, 1.33)	

Table 8 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Had University education (R)								
<i>Employment status</i>								
Employed			0.94	(0.34, 2.57)	0.94	(0.34, 2.57)	0.94	(0.34, 2.59)
Not working			1.20	(0.98, 1.48)	1.20	(0.98, 1.48)	1.19	(0.96, 1.47)
Unemployed (R)								
<i>Smoke</i>								
Former smoker								
Current smoke								
Never smoked (R)					1.05			(0.81, 1.39)
<i>Drink</i>								
Former drinker							0.91	(0.66, 1.24)
Current drinker							0.80*	(0.66, 0.96)
Never drunk (R)								
<i>Physical activity</i>								
< 3 times per							0.82	(0.67, 1.01)
≥ 3 times per							0.71**	(0.58, 0.87)
Not at all (R)								
<i>n</i>		1598		1598		1598		1441
-2log(L)		11,469.28		11,452.73		11,265.44		10,150.89
AIC		11,475.28		11,462.73		11,295.44		10,192.89

*Indicate $p < 0.05$; ** indicate $p < 0.01$; AIC indicates Akaike Information Criterion (lower the AIC value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries
 Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

Table 9 Cox regression results with time-varying covariates for men aged 50+, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability with nativity status combined with duration of residence as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
<i>DoR</i>								
ES < 10	0.51	(0.19, 1.37)	0.51	(0.19, 1.37)	0.53	(0.20, 1.41)	0.45	(0.11, 1.82)
ES 10 to 19	0.61	(0.31, 1.24)	0.61	(0.31, 1.24)	0.80	(0.39, 1.62)	0.77	(0.38, 1.56)
ES ≥ 20	0.92	(0.74, 1.16)	0.92	(0.74, 1.16)	0.94	(0.75, 1.19)	0.92	(0.73, 1.17)
NES < 10	1.15	(0.60, 2.23)	1.11	(0.51, 2.40)	0.88	(0.40, 1.93)	0.77	(0.33, 1.80)
NES 10 to 19	0.64	(0.30, 1.36)	0.63	(0.27, 1.43)	0.56	(0.24, 1.32)	0.65	(0.27, 1.54)
NES ≥ 20	1.11	(0.88, 1.41)	1.11	(0.82, 1.50)	0.95	(0.70, 1.30)	0.95	(0.69, 1.32)
Australia (R)								
<i>Age group</i>								
45–59 years	2.45**	(1.97, 3.05)	2.45**	(1.97, 3.06)	2.77**	(2.18, 3.51)	3.04**	(2.36, 3.92)
≥ 60 (R)								
<i>English language proficiency</i>								
Good			0.98	(0.65, 1.48)	1.03	(0.68, 1.58)	1.00	(0.64, 1.55)
Not good			1.32	(0.63, 2.75)	0.95	(0.45, 2.01)	1.24	(0.55, 2.82)
Proficient (R)								
<i>Household equivalised income</i>								
≤ 20,000					3.97**	(2.91, 5.41)	3.95**	(2.87, 5.45)
(20,000–40,000)					1.99**	(1.49, 2.68)	2.05**	(1.51, 2.77)
(40,000–60,000)					1.53*	(1.10, 2.12)	1.54*	(1.10, 2.15)
≥ 60,000 (R)								
<i>Marital status</i>								
Separated/Widowed					0.87	(0.70, 1.08)	0.88	(0.70, 1.10)
Never married					0.78	(0.53, 1.14)	0.86	(0.57, 1.29)

Table 9 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
Married (R)								
<i>Level of education</i>								
<12 years of schooling		1.26	(0.97, 1.63)	1.17	(0.89, 1.53)			
12 years of schooling		1.17	(0.81, 1.69)	1.18	(0.81, 1.71)			
Diploma/certificate		1.23	(0.96, 1.59)	1.16	(0.90, 1.50)			
Had University education (R)								
<i>Employment status</i>								
Employed			0.95	(0.51, 1.76)	0.86	(0.46, 1.62)		
Not working			1.12	(0.92, 1.37)	1.10	(0.90, 1.36)		
Unemployed (R)								
<i>Smoke</i>								
Former smoker					1.17	(0.97, 1.40)		
Current smoker					1.13	(0.86, 1.49)		
Never smoked (R)								
<i>Drink</i>								
Former drinker					0.88	(0.59, 1.31)		
Current drinker					0.77	(0.57, 1.04)		
Never drinker (R)								
<i>Physical activity</i>								
<3 times per week					0.95	(0.75, 1.22)		
≥ 3 times pe					0.78*	(0.62, 0.99)		
Not at all (R)								
<i>n</i>		1325		1325		1324		1227

Table 9 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
$-2\log(L)$		8754.147		8753.525		8583.872		7977.778
<i>AIC</i>		8768.147		8771.525		8621.872		8027.778

* Indicate $p < 0.05$; ** indicate $p < 0.01$; *AIC* indicates Akaike Information Criterion (lower the *AIC* value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries. DoR is categorised into less than 10 years, 10–19 years, and greater than or equal 20 years in Australia, and combined with the nativity status variable described above

Model I includes age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

Table 10 Cox regression results with time-varying covariates for women aged 50+, showing hazard ratio (HR) and their 95% confidence intervals (CI) for the risk of incidence of long-term disability by nativity status combined with duration of residence as the main exposure variable

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
<i>DoR</i>								
ES < 10	1.20	(0.50, 2.89)	1.20	(0.50, 2.89)	1.05	(0.43, 2.55)	1.10	(0.45, 2.69)
ES 10 to 19	0.65	(0.35, 1.21)	0.65	(0.35, 1.22)	0.74	(0.39, 1.38)	0.64	(0.32, 1.29)
ES ≥ 20	0.98	(0.79, 1.22)	0.98	(0.79, 1.22)	1.07	(0.86, 1.33)	1.09	(0.87, 1.37)
NES < 10	0.77	(0.35, 1.73)	0.39*	(0.16, 0.95)	0.47	(0.20, 1.13)	0.44	(0.17, 1.18)
NES 10 to 19	1.13	(0.69, 1.86)	0.66	(0.37, 1.19)	0.70	(0.39, 1.25)	0.74	(0.40, 1.40)
NES ≥ 20	0.96	(0.76, 1.20)	0.70*	(0.51, 0.96)	0.74	(0.54, 1.00)	0.70*	(0.49, 0.98)
Australia (R)								
<i>Age group</i>								
45–59 years	3.10**	(2.58, 3.72)	3.06**	(2.55, 3.68)	3.99**	(3.27, 4.86)	3.92**	(3.19, 4.82)
≥ 0 (R)								
<i>English language proficiency</i>								
Good			1.41	(0.99, 2.02)	1.17	(0.82, 1.67)	1.11	(0.75, 1.63)
Not good			3.06**	(1.87, 5.01)	1.88*	(1.15, 3.08)	2.81**	(1.55, 5.11)
Proficient (R)								
<i>Household equivalised income</i>								
≤ 20,000					3.51**	(2.57, 4.78)	3.55**	(2.57, 4.91)
(20,000–40,0					1.77**	(1.30, 2.40)	1.75**	(1.28, 2.40)
(40,000–60,0					1.52*	(1.09, 2.11)	1.58**	(1.12, 2.22)
≥ 0,000 (R)								
<i>Marital status</i>								
Separated/Widowed			1.04	(0.90, 1.20)	1.04	(0.90, 1.20)	1.06	(0.91, 1.23)

Table 10 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
Never married			0.96	(0.63, 1.46)	0.94	(0.61, 1.45)		
Married (R)								
<i>Level of education</i>								
<12 years of schooling		1.09	(0.86, 1.37)	1.08	(0.84, 1.38)			
12 years of schooling		1.12	(0.81, 1.56)	1.13	(0.80, 1.59)			
Diploma/certificate		0.99	(0.76, 1.29)	0.99	(0.75, 1.31)			
Had University education (R)								
<i>Employment status</i>								
Employed			0.95	(0.35, 2.61)	0.96	(0.35, 2.66)		
Not working			1.21	(0.98, 1.48)	1.19	(0.96, 1.47)		
Unemployed (R)								
<i>Smoke</i>								
Former smoker					1.05	(0.90, 1.24)		
Current smoker					1.05	(0.80, 1.38)		
Never smoked (R)								
<i>Drink</i>								
Former drinker					0.90	(0.65, 1.22)		
Current drinker					0.79*	(0.66, 0.95)		
Never drunk (R)								
<i>Physical activity</i>								
<3 times per week					0.82	(0.66, 1.00)		
≥ 3 times pe					0.71**	(0.58, 0.87)		
Not at all (R)								

Table 10 (continued)

Characteristic	Model I		Model II		Model III		Model IV	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
<i>n</i>		1598		1598		1596		1441
$-2\log(L)$		11,466.59		11,448.73		11,262.9		10,147.45
<i>AIC</i>		11,480.59		11,466.73		11,300.9		10,197.45

*Indicate $p < 0.05$; ** indicate $p < 0.01$; *AIC* indicates Akaike Information Criterion (lower the *AIC* value better the fit is)

Nativity is categorised as NB (native-born), FB (foreign-born) from English-speaking (ES) and non-English-speaking (NES) countries. DoR is categorised into less than 10 years, 10–19 years, and greater than or equal 20 years in Australia, and combined with the nativity status variable described above

Model I include age as the covariate. Model II adds English language proficiency to the covariates of Model I. Model III adds household equivalised income, marital status, level of education and labour force participation status to the covariates of Model II. Model IV adds health behaviour variables (smoking, drinking and physical activity) to the covariates of Model III

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Data availability Data from the Household, Income and Labour Dynamics in Australia (HILDA) are publicly available to researchers upon application.

Code availability Not applicable.

Declarations

Conflict of interests Not applicable.

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