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Influenza vaccination coverage in a population-based cohort of Australian-born Aboriginal and non-Indigenous older adults

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Abstract

Background

There is limited information on vaccination coverage and characteristics associated with vaccine uptake in Aboriginal and/or Torres Strait Islander adults. We aimed to provide more current estimates of influenza vaccination coverage in Aboriginal adults.

Methods

Self-reported vaccination status (n=559 Aboriginal and/or Torres Strait Islander participants, n=80,655 non-Indigenous participants) from the 45 and Up Study, a large cohort of adults aged 45 years or older, was used to compare influenza vaccination coverage in Aboriginal and/or Torres Strait Islander adults with coverage in non-Indigenous adults.

Results

Of Aboriginal and non-Indigenous respondents aged 49 to <65 years, age-standardised influenza coverage was respectively 45.2% (95% CI 39.5–50.9%) and 38.5%, (37.9–39.0%), *p*-value for heterogeneity=0.02. Coverage for Aboriginal and non-Indigenous respondents aged ≥65 years was respectively 67.3% (59.9–74.7%) and 72.6% (72.2–73.0%), *p*-heterogeneity=0.16. Among Aboriginal adults, coverage was higher in obese than in healthy weight participants (adjusted odds ratio (aOR)=2.38, 95%CI 1.44–3.94); in those aged <65 years with a medical risk factor than in those without medical risk factors (aOR=2.13, 1.37–3.30); and in those who rated their health as fair/poor compared to those who rated it excellent (aOR=2.57, 1.26–5.20). Similar associations were found among non-Indigenous adults.

Conclusions

In this sample of adults ≥65 years, self-reported influenza vaccine coverage was not significantly different between Aboriginal and non-Indigenous adults whereas in those <65 years, coverage was higher among Aboriginal adults. Overall, coverage in the whole cohort was suboptimal. If these findings are replicated in other samples and in the Australian Immunisation Register, it suggests that measures to improve uptake, such as communication about the importance of influenza vaccine and more effective reminder systems, are needed among adults.

Keywords: Aboriginal, Vaccination, Influenza, Coverage

Introduction

In Australia, vaccine-preventable diseases disproportionately affect Aboriginal and Torres Strait Islander (hereafter respectfully referred to as Aboriginal) adults and children. Rates for influenza hospitalisation are significantly higher in Aboriginal adults than in non-Indigenous adults. Between 2010 and 2013, rates among Aboriginal adults aged 50–64 years were estimated to be more than four times higher than those in non-Indigenous adults. This difference is thought to be due to higher prevalence of comorbidities associated with an increased risk of severe influenza among Aboriginal adults.¹

Vaccination is the key public health action to prevent the spread of infectious diseases such as influenza. In particular, adult vaccination is important as increasing the rates of coverage is a cost-effective measure that could have a significant impact on influenza morbidity and mortality, and coverage rates are currently low.² Hence ensuring the adult influenza vaccination program is working effectively is imperative and vaccination coverage is a key measure of program success.

Recommendations and funding for influenza vaccine have varied over the years and across jurisdictions.³ The National Immunisation Program (NIP) in Australia provides free vaccination to groups at high risk of disease and since 1999 annual influenza vaccine has been available through the program for all adults aged ≥ 65 years. Recognising the greater burden of influenza in Aboriginal populations, since 2010, annual influenza vaccine has also been provided free for all Aboriginal adults aged ≥ 15 years and pregnant women, and in 2015 Aboriginal children aged >6 months to <5 years were also eligible for free influenza vaccine.³ As of December 2018 the Pharmaceutical Benefits Advisory Committee also recommended that annual influenza vaccine also be provided to all Aboriginal children aged 5–14 years.⁴

Despite the higher burden of influenza in Aboriginal adults and targeting for free influ-

enza vaccination under the National program, there is very limited information on uptake of vaccination in Aboriginal adults. A systematic review in 2015 identified seven reports of vaccination coverage in Aboriginal adults, all conducted prior to 2010, before eligibility for influenza vaccination in this group was expanded.² The review found coverage for those aged ≥ 50 years ranged from 51% to 96%,^{5–7} and coverage for those aged ≥ 65 years ranged from 71% to 89%.^{7–9} Since 2010, we identified a further study reporting influenza vaccination coverage in Aboriginal adults. Among Aboriginal peoples aged ≥ 50 years and 15–49 years, influenza vaccination coverage in the previous 12 months was 57% and 28% respectively.¹⁰

To add to the limited information on this topic, we used data collected in a cohort study of adults aged ≥ 49 years during 2012–2014 to provide more contemporaneous estimates of influenza vaccination coverage in Aboriginal adults and to compare these estimates to those for Australian-born non-Indigenous adults recruited into the same cohort study.

Methods

Study sample

The Sax Institute's 45 and Up Study is a large prospective cohort study ($n=267,153$) of adults aged ≥ 45 years at recruitment aiming to investigate healthy ageing. Participants were randomly sampled from the Australian universal health insurance database, Medicare, and were resident in the Australian state of New South Wales (NSW). To provide adequate statistical power those aged 80 years and older and rural and remote residents were oversampled. The study recruitment methods have been described in detail elsewhere.¹¹

A recruitment questionnaire was posted between January 2006 and December 2008, collecting detailed information on demographic, health and behavioural factors. A total of 267,153 people completed the baseline questionnaire, approximately 1 in 10 people in this age group

in NSW.¹² Of the total baseline cohort, 0.7% of participants were Aboriginal and/or Torres Strait Islander adults.¹³ Follow-up of participants is ongoing, with postal questionnaires including questions about vaccination for influenza and pertussis sent to participants about five years after recruitment.¹ At the time of analysis, follow-up data were available for 105,902 participants who completed a questionnaire sent to them in either September 2012 (survey mailed to 41,400 participants, return rate=65%), November 2013 (survey mailed to 86,250 participants, return rate=58%) or December 2014 (survey mailed to 52,644 participants, return rate=54%).¹²

Statistical analysis

We excluded participants whose Aboriginality status was unknown, who were overseas-born or had unknown country of birth, based on recruitment questionnaire data. Those with unknown influenza vaccination status (including those with no vaccination date) were excluded from analyses. Participants were categorised as Aboriginal and/or Torres Strait Islander if they answered 'yes' to the question 'Are you of Aboriginal or Torres Strait Islander origin?', or Australian-born non-Indigenous if they answered 'no' and indicated their country of birth as 'Australia'. Influenza vaccination coverage was calculated as the percentage of those reporting influenza vaccination within the last year who answered 'yes' to the question 'Have you ever had the flu vaccine?', and for whom the date of vaccination was less than a year prior to the date that they completed their questionnaire. Annual uptake of influenza vaccination was examined separately in Aboriginal and Australian-born non-Indigenous participants. Crude and age-standardised influenza vaccination uptake was estimated, using the 2011 Australian Census Population data¹⁴ in 5-year age groups for age-standardisation. Significant differences in vaccination uptake were tested for using the two sample test of proportions (Z-test). Vaccination was examined by: age at

completion of follow-up questionnaire (49–64 and ≥65 years), sex, annual household income (<\$50,000, ≥\$50,000), education (university, no university), area of residence (major city, inner regional, outer regional, or remote based on the Accessibility/Remoteness Index of Australia (ARIA)),¹⁵ in paid employment (yes, no), smoking status (never, past, current), alcohol consumption (non-drinkers, 1–7 drinks per week, >7 drinks per week), body mass index (BMI) (<18.5 kg/m², 18.5–<25 kg/m², 25–<30 kg/m², ≥ 30kg/m²), self-rated health (excellent, very good/good, fair/poor) and underlying medical condition (stroke, asthma, diabetes, heart disease, Parkinson's disease and cancer). Logistic regression was used to examine associations between the factors and the likelihood of influenza vaccination with separate models for Aboriginal and non-Indigenous participants. Regression models were adjusted for age (in 5-year age categories) and sex. The variables sex, Aboriginality, country of birth, area of residence and BMI were obtained from the baseline questionnaire. All other variables were obtained from the follow-up questionnaire.

All analyses were undertaken using Stata 12.0.¹⁵

Ethical approval

This study was approved by the NSW Population and Health Services Research Ethics committee, the University of New South Wales Human Research Ethics Committee (HREC/10/CIPHS/97) and the Aboriginal Health and Medical Research Council of NSW Ethics Committee (1169/16). Written consent was obtained from all study participants.

Results

Of the 105,902 participants, 82,413 were Australian-born. The response rate to the follow-up questionnaire according to Aboriginality and other characteristics is shown in the appendix. The response rate was lower among Aboriginal participants than non-Indigenous participants (42.7% and 61.3% respectively). For Aboriginal participants, responders and non-responders

i Both questionnaires are available at: www.saxinstitute.org.au/our-work/45-up-study/questionnaires/.

were of a similar age (49–64 years 42.9%, ≥65 years 42.1%). Aboriginal responders were more likely than Aboriginal non-responders to: have a university education compared to no university education (54.1% vs 41.6%), live in a city compared to living in inner regional or outer regional/remote areas (45.3%, 41.9% and 39.5% respectively) and to be in paid employment compared to no paid employment (47.5% vs 38.2%). For non-Indigenous participants, responders were more likely than non-Indigenous non-responders to: be younger (49–64 years 63.8%, ≥65 years 56.2%); have a university education compared to no university education (73.2% vs 58.0%); and be in paid employment compared to no paid employment (64.5% vs 57.8%). Response rates were similar among non-Indigenous participants for those living in a city compared to inner regional or outer regional/remote areas (61.1%, 61.7% and 60.1% respectively).

Among respondents, 1,199/82,413 (1.5%) had an unknown influenza immunisation status, yielding data for 81,214 cohort members, of whom 559 were Aboriginal and 80,655 Australian-born non-Indigenous (Aboriginal peoples represent 3.1% of the NSW population).¹⁶ The characteristics of the participants according to Aboriginality are shown in Table 1. Compared to Australian-born non-Indigenous participants, Aboriginal participants were on average younger, more likely to reside in rural or remote areas, less likely to be university educated or be in paid employment, had lower household incomes, more likely to be smokers, have a higher average BMI and have one or more pre-existing medical conditions increasing the risk of serious complications from influenza.¹⁷

Comparing influenza vaccination in Aboriginal and Australian-born non-Indigenous adults for all ages, age-standardised estimates were similar; 54.4% (95%CI 49.9–58.9%) versus 52.7% (52.4–53.1%) respectively; $p=0.5$. For adults aged ≥65 years, age-standardised coverage estimates were not statistically different comparing Aboriginal and non-Indigenous adults (67.3% vs 72.6%, $p=0.16$). For adults aged 49–64 years, influenza vaccination coverage was significantly

higher in Aboriginal versus non-Indigenous participants (45.2% vs 38.5%, $p=0.02$), and for adults whose annual household income was <\$50,000, coverage was significantly higher in Aboriginal versus non-Indigenous participants (58.3% vs 51.1%, $p=0.03$).

For non-Indigenous participants, significantly higher uptake was observed in those ≥65 years than in those aged 49–64 years (adjusted OR=6.44, 95%CI 5.91–7.01); in women than in men (aOR=1.22, 1.18–1.25); in those with an annual household income ≥\$50,000 (aOR=1.06, 1.02–1.09); in those who were overweight or obese than in those of healthy weight (aOR=1.17, 1.13–1.21; aOR=1.40, 1.34–1.45 respectively); in those who had a medical condition associated with higher risk of complications irrespective of age (aOR=1.93, 1.83–2.02, aOR=1.44, 1.37–1.51); and in those who reported good/very good or fair/poor health than in those who reported excellent health (aOR=1.41, 1.35–1.47; aOR=1.93, 1.82–2.05 respectively). Characteristics associated with a lower uptake of vaccination included living in inner regional or outer regional/remote areas compared to those living in cities (aOR=0.93, 0.90–0.96; aOR=0.84, 0.80–0.87 respectively); being in paid employment (aOR=0.81, 0.78–0.84); and current smokers compared to those who never smoked (aOR=0.70, 0.65–0.75).

Our analysis of Aboriginal participants found significantly higher uptake only in those who were obese than in those of healthy weight (aOR=2.38, 95%CI 1.44–3.94); in those aged 49–64 years with a medical risk factor than in those of any age without risk factors (aOR=2.13, 1.37–3.30); and in those who rated their health as fair/poor versus excellent (aOR=2.57, 1.26–5.20).

Discussion

We conducted this study to add to the very limited contemporaneous data available reporting influenza vaccination in Aboriginal adults in Australia. We found that reported influenza vaccination coverage was marginally higher in non-Indigenous adults than in Aboriginal

Table 1: Characteristics of study participants according to Aboriginal status

	Aboriginal adults (total = 559)		Australian-born non-Indigenous adults (total = 80,655)	
statistics	%	SD	%	SD
mean age	63.1	8.2	66.2	9.7
mean BMI, kg/m ²	28.6	5.5	27.0	4.8
characteristics	%	N	%	N
<65 years	65.3	365	50.2	40,500
men	42.6	238	43.3	34,927
reside in outer regional/remote	20.4	114	12.8	10,094
university educated	19.0	106	27.4	21,963
annual household income <\$50,000	48.8	273	39.5	31,458
currently in paid employment	39.4	220	41.6	33,548
current smoker	10.7	60	4.0	3,183
past smoker	41.7	233	33.8	26,945
consuming >7 drinks a week	30.8	172	33.1	26,710
reporting medical condition ^a	41.0	229	30.7	24,745

% represent the proportion in each column (excluding missing observations)

a Stroke, asthma, diabetes, heart disease, Parkinson's disease and cancer

adults aged ≥ 65 years, however this was not statistically significant. Coverage was higher in Aboriginal adults aged 49–64 years than in their Australian-born non-Indigenous counterparts. Given that all those aged ≥ 15 years are eligible for free vaccine, the overall uptake of influenza vaccination in Aboriginal adults was still low with less than half of those aged 49–64 years reporting receiving the vaccine. The vaccination uptake for funded childhood immunisations is in excess of 90%, but much lower for funded adult vaccines in Australia, in the range 50–60%.¹⁸ The vaccination gap between adults and children, whether Aboriginal or non-Indigenous, is an area for improvement nationally. A rise in coverage from 50 to 80% could result in substantial gains in disease prevention.¹⁹

The rate of influenza vaccine coverage in Aboriginal adults aged ≥ 65 years found in this study (67.3%, 95%CI 59.9–74.7%) is lower than that reported in earlier studies with estimates ranging from 71% to 84% in Aboriginal peoples nationally. However, NSW-specific estimates in these earlier studies have been lower than the national average.^{7–9} Earlier estimates may

differ from the current analysis as they were from national studies whilst our study was in NSW residents only. Barriers to increasing adult vaccination coverage differ from those related to childhood vaccination. Vaccination is often undervalued and financial support is less than that provided for childhood vaccines.²⁰ Reviews have found interventions shown to increase adult vaccination coverage include increasing access (i.e. home visits), incentives for patients and provider, and provider recalls.^{20,21}

Among responders aged 49–64 years, Aboriginal participants had higher vaccination coverage than non-Indigenous adults. This suggests that the NIP recommendations and targeted funding for influenza vaccine in Aboriginal peoples aged ≥ 15 years has had a measureable impact. The most recent nationally reported data for influenza vaccine coverage in Aboriginal adults aged <50 years was the 2012–2013 Aboriginal and Torres Strait Islander Health Survey which reported coverage of 56.8%,²² marginally higher than our estimate. Previous estimates in those aged ≥ 50 years from 1995 to 2003 range from 51% to 96%.² The 2009 Adult Immunisation

Table 2: Crude and age-standardised annual influenza vaccination coverage in Aboriginal and Australian-born non-Indigenous adults

Characteristics	Aboriginal adults			Australian-born Non-Indigenous adults			p-value ^a
	Total population	Crude vaccination coverage %	Age-standardised vaccination coverage % (95% CI)	Total population	Crude vaccination coverage %	Age-standardised vaccination coverage % (95% CI)	
Total population	559	54.4	54.4 (49.9–58.9)	80,655	55.8	52.7 (52.4–53.1)	0.460
Age group (years)							
49–64 ^b	365	47.7	45.2 (39.5–50.9)	40,500	40.3	38.5 (37.9–39.0)	0.021
>65 ^b	194	67.0	67.3 (59.9–74.7)	40,155	71.4	72.6 (72.2–73.0)	0.160
Sex							
Men	238	52.1	50.6 (43.4–57.8)	34,927	54.9	50.0 (49.4–50.5)	0.870
Women	321	56.1	56.4 (50.4–62.3)	45,728	56.4	54.5 (54.1–55.0)	0.532
Place of residence							
Major cities	229	55.9	56.6 (49.9–63.3)	37,618	56.6	53.9 (53.4–54.4)	0.430
Inner regional	207	53.6	50.4 (42.4–58.4)	31,196	55.8	52.2 (51.6–52.8)	0.660
Outer regional/remote/very remote	114	52.6	51.2 (42.2–60.3)	10,094	53.2	49.9 (48.9–50.9)	0.779
Annual household income (\$AUD)							
<50,000	273	56.8	58.3 (51.9–64.7)	31,458	61.5	51.1 (50.4–51.9)	0.029
>50,000	253	51.4	53.7 (46.6–60.7)	44,958	50.8	53.2 (52.8–53.7)	0.889
University education							
No	449	53.0	52.1 (47.1–57.1)	58,057	57.1	52.3 (51.8–52.7)	0.937
Yes ^b	106	59.4	59.2 (50.8–67.6)	21,963	52.2	53.6 (52.9–54.3)	0.192

Characteristics	Aboriginal adults			Australian-born Non-Indigenous adults			p-value ^a
	Total population	Crude vaccination coverage %	Age-standardised vaccination coverage % (95% CI)	Total population	Crude vaccination coverage %	Age-standardised vaccination coverage % (95% CI)	
Paid employment							
No	339	60.2	54.9 (48.6–61.1)	47,107	65.5	53.5 (52.7–54.3)	0.663
Yes ^b	220	45.4	41.4 (31.6–51.1)	33,548	42.2	49.5 (48.7–50.3)	0.104
Smoking							
Never	259	54.4	54.2 (47.6–60.9)	49,538	55.7	52.8 (52.3–53.2)	0.680
Past	233	56.6	57.3 (50.4–64.2)	26,945	57.6	53.7 (53.1–54.4)	0.308
Current	60	46.7	40.7 (29.6–51.8)	3,183	39.9	44.8 (42.8–46.8)	0.476
Alcohol consumption/week							
None	229	56.7	55.4 (48.0–62.7)	24,874	58.7	53.4 (52.7–54.1)	0.595
1–7 drinks ^b	158	59.5	60.8 (52.6–68.9)	29,071	56.5	54.4 (53.8–55.0)	0.124
>7 drinks	172	46.5	46.9 (38.2–55.6)	26,710	52.3	50.5 (49.9–51.1)	0.418
BMI (kg/m²)							
<18.5	NC ^c	–	–	717	53.9	49.0 (45.3–52.6)	–
18.5–24.9	113	45.1	48.7 (40.5–56.9)	27,251	52.9	50.4 (49.8–51.0)	0.685
25–29.9	210	51.9	52.2 (44.4–59.9)	30,292	56.5	52.5 (51.9–53.1)	0.939
>30 ^b	172	64.5	61.7 (53.0–70.4)	17,009	58.9	56.6 (55.8–57.4)	0.252
Missing	54	48.1	49.8 (36.9–62.7)	5,386	56.9	52.8 (51.4–54.2)	0.650
Medical conditions^d and age							
No	330	47.3	50.3 (44.6–55.9)	55,910	50.9	49.6 (49.2–50.1)	0.808
Yes (age <65 yrs) ^b	135	60.0	57.6 (47.5–67.6)	10,045	52.7	50.0 (48.9–51.2)	0.140

Characteristics	Aboriginal adults			Australian-born Non-Indigenous adults			p-value ^a
	Total population	Crude vaccination coverage %	Age-standardised vaccination coverage % (95% CI)	Total population	Crude vaccination coverage %	Age-standardised vaccination coverage % (95% CI)	
Yes (age =>65 yrs) ^b	94	71.3	67.3 (56.0–78.5)	14,700	76.5	76.7 (76.1–77.4)	0.102
Self-reported general health status							
Excellent	46	41.3	45.8 (31.2–60.5)	11,955	43.3	46.4 (45.5–47.4)	0.936
Very good/good	365	52.0	52.4 (46.9–57.9)	57,443	56.3	53.0 (52.6–53.4)	0.831
Fair/poor	128	62.5	63.4 (54.4–72.4)	9,922	66.6	59.6 (58.5–60.7)	0.500

a Two-sample test of difference in proportions between age-standardised vaccination coverage for Aboriginal and non-Indigenous adults

b Difference in age-standardised vaccination coverage between Aboriginal and non-Indigenous adults greater than 5 percentage points

c not calculated due to small numbers

d Stroke, asthma, diabetes, heart disease, Parkinson's disease and cancer

Table 3: Age- and sex-adjusted odds ratio for association between various characteristics and influenza vaccination in Aboriginal and Australian-born non-Indigenous adults

Characteristics	Aboriginal adults	Australian-born Non-Indigenous adults
Age group (years)		
49–64	1.00	1.00
>65	3.02 (0.71–12.93)	6.44 (5.91–7.01)
Sex		
Men	1.00	1.00
Women	1.26 (0.89–1.79)	1.22 (1.18–1.25)
Place of residence		
Major cities	1.00	1.00
Inner regional	0.88 (0.60–1.30)	0.93 (0.90–0.96)
Outer regional/remote/very remote	0.93 (0.58–1.48)	0.84 (0.80–0.87)
Annual household income (\$)		
<50,000	1.00	1.00
>50,000	1.02 (0.71–1.47)	1.06 (1.02–1.09)
University Education		
No	1.00	1.00
Yes	1.50 (0.97–2.35)	1.04 (1.01–1.08)
In paid employment		
No	1.00	1.00
Yes	0.78 (0.53–1.15)	0.81 (0.78–0.84)
Smoking		
Never	1.00	1.00
Past	1.12 (0.77–1.61)	1.09 (1.06–1.12)
Current	0.82 (0.46–1.47)	0.70 (0.65–0.75)
Alcohol consumption/week		
None	1.00	1.00
1–7 drinks	1.16 (0.75–1.77)	1.07 (1.03–1.11)
>7 drinks	0.75 (0.49–1.15)	0.93 (0.89–0.97)
BMI (kg/m²)		
<18.5	3.34 (0.78–14.20)	0.94 (0.80–1.11)
18.5–24.9	1.00	1.00
25–29.9	1.29 (0.80–2.09)	1.17 (1.13–1.21)
>30	2.38 (1.44–3.94)	1.40 (1.34–1.45)
Missing	1.09 (0.55–2.14)	1.11 (1.05–1.19)

Characteristics	Aboriginal adults	Australian-born Non-Indigenous adults
Medical conditions^a and age		
No	1.00	1.00
Yes (age <65 yrs)	2.13 (1.37–3.30)	1.93 (1.83–2.02)
Yes (age >65 yrs)	1.47 (0.79–2.69)	1.44 (1.37–1.51)
Self-reported general health status		
Excellent	1.00	1.00
Very good/good	1.56 (0.82–2.95)	1.41 (1.35–1.47)
Fair/poor	2.57 (1.26–5.20)	1.93 (1.82–2.05)

a Stroke, asthma, diabetes, heart disease, Parkinson's disease and cancer

Survey for Aboriginal people aged >18 years reported coverage of 27.5% for influenza vaccination.²³ This variability and inconsistency in reporting of vaccination coverage in Aboriginal adults likely reflects the small sample sizes and highlights the need for more robust and up-to-date coverage estimates. Apart from our study, almost all other reports were conducted prior to 2010 when national funding for influenza vaccination for Aboriginal adults changed from those aged <50 with a medical indication for influenza vaccine to all Aboriginal peoples aged ≥15 years.²⁴

Unlike many other surveys of vaccination uptake, we conducted this cross-sectional analysis within an established cohort study. A more representative population sample may be preferable for a study of vaccine uptake. However, given the paucity of available information on vaccination in Aboriginal adults² and the relatively large sample of participants who had completed the question on influenza vaccination, our results make a significant contribution to what is known about influenza vaccination in Aboriginal adults. Additionally, the cohort enabled us to make comparisons of vaccine uptake between Aboriginal and non-Indigenous adults who were recruited using a similar strategy, were Australian born, and had information on other characteristics enabling comparisons to be made regarding representativeness, a feature that many other studies that examine only Aboriginal populations lack.

Previous analysis comparing Aboriginal participants who responded to the 45 and Up Study baseline questionnaire to 2006 NSW Census data showed Aboriginal participants had higher education levels and a lower proportion of those ≥65 years who needed help with daily tasks.¹³ Similar to our findings, a report including 99,927 follow up participants of the 45 and Up Study found that response rates from Aboriginal participants were lower than that for non-Indigenous participants (45% compared to 61%). Factors associated with lower response were similar in both groups, with those who were ill or disadvantaged less likely to respond to the follow up questionnaire. Additionally, Aboriginal participants who reported smoking or an annual household income of <\$50,000 were less likely to respond than the same groups of non-Indigenous participants.²⁵ These differences in response are likely to mean that our estimates of coverage are slight overestimates, with more of an overestimation in Aboriginal than in non-Indigenous adults.²⁶ We were able to exclude overseas-born participants as we know from earlier studies that this group have significantly lower influenza vaccine uptake.²⁷

We acknowledge the possibility of responder bias which will impact the representativeness and generalisability of these results. However, comparisons to other NSW data sources show that a number of characteristics within this sample of Aboriginal adults were not substantially different. Data from the 2012–2013 Australian Aboriginal and Torres Strait Islander Health

Survey shows that the proportion of those never smoking was 25% and 32% in those aged 45–54 years and those aged ≥ 55 years respectively, compared to 47% of our sample of Aboriginal participants aged 49+ years. The same survey reports that those who are overweight or obese is 74% and 77% in the same age groups,²⁸ compared to 77% in our sample. Census data from the Australian Bureau of Statistics shows a geographical population spread in NSW of 42% of Aboriginal adults aged ≥ 45 years living in major cities, 33% living in inner regional areas and 25% living in remote areas.²⁹ Similarly, 42% of our sample lived in major cities, 28% in inner regional areas and 21% in remote areas.

The study used self-report to determine vaccination status and this introduces the possibility of misclassification. However, self-reported influenza vaccination status has been shown to be reasonably accurate^{30,31} and it is used widely in surveys of adults to estimate coverage.²³ Potential bias in our findings could result if accuracy of self-report differed between the comparison groups. Other limitations include the small sample size of Aboriginal participants, which leads to greater uncertainty around the point estimates and the fact our study was limited to adults in NSW.

Increasing vaccination coverage could help to decrease hospitalisations and deaths caused by influenza in Australian adults. This is particularly important for Aboriginal adults who are at higher risk of complications from influenza due to higher prevalence of chronic conditions.¹ Research suggests that whilst providing funding for vaccination is important to improve adult coverage, there are other initiatives which could improve uptake. Some strategies which have been shown to be effective include reminders for adults,³² working with primary health care practices to identify a staff member to drive influenza campaigns,³³ targeting of people within geographic regions with high disease rates³⁴ and specifically for Aboriginal populations having dedicated Aboriginal Health Workers which has had a demonstrable effect on increasing vaccination coverage in Aboriginal children.³⁵

Evaluating the effectiveness of programs to improve adult vaccination uptake is an important area for future research.

Conclusion

This study adds to existing knowledge by providing estimates of vaccination coverage in Aboriginal adults and examining differences between Aboriginal and non-Indigenous adults. Overall, given responder bias, our findings suggest for those aged ≥ 65 years, vaccination coverage in Aboriginal adults is lower than Australian-born non-Indigenous adults, and among those 49–64 years is higher among Aboriginal compared to non-Indigenous adults. However given Aboriginal adults aged ≥ 15 years are funded by the NIP to receive annual influenza vaccine, the overall estimate of $\sim 50\%$ uptake in adults aged 49 years and greater, are inadequate.¹⁹ The introduction of the all of age Australian Immunisation Register³⁶ should allow for more systematic and regular monitoring of vaccine uptake in this priority population. We also note that while our study has limitations, they also highlight the need for much better and more contemporary data on influenza vaccine uptake in Aboriginal adults.

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Appendix A

Table 4: Follow up questionnaire response rate (by characteristics reported at baseline)

	Aboriginal			Australian-born non-Indigenous		
	Responded	Invited	Response rate (%)	Responded	Invited	Response rate (%)
Total	568	1,329	47.2	81,845	133,541	61.3
Age at baseline (years)						
49–64	464	1,082	42.9	57,029	89,350	63.8
≥65	104	247	42.1	24,816	44,191	56.2
Sex						
men	241	555	43.4	35,587	58,452	60.9
women	327	774	42.2	46,258	75,089	61.6
Place of residence						
major cities	233	514	45.3	38,202	62,510	61.1
inner regional	210	501	41.9	31,617	51,227	61.7
outer regional/remote	116	294	39.5	10,252	17,054	60.1
University education						
No	457	1,099	41.6	58,859	101,534	58.0
Yes	106	196	54.1	22,345	30,509	73.2
In paid employment						
No	259	678	38.2	37,004	64,034	57.8
Yes	309	651	47.5	44,841	69,507	64.5
Need assistance with daily tasks						
No	482	1,096	44.0	76,656	122,478	62.6
Yes	56	145	38.6	2,429	5,433	44.7

	Aboriginal			Australian-born non-Indigenous		
	Responded	Invited	Response rate (%)	Responded	Invited	Response rate (%)
Smoker						
never	254	566	44.9	49,831	78,645	63.4
past	223	476	46.8	27,421	45,351	60.5
current	91	286	31.8	4,571	9,515	48.0
BMI (kg/m²)						
<18.5	10	25	40.0	732	1,298	56.4
18.5–24.9	115	279	41.2	27,647	43,213	64.0
25–29.9	213	444	48.0	30,744	49,421	62.2
30+	176	429	41.0	17,238	29,590	58.3
Missing	54	152	35.5	5,484	10,019	54.7
Medical condition^a						
No	367	853	43.0	60,098	96,036	62.6
Yes	201	476	42.2	21,747	37,505	58.0
Self-reported general health status						
Excellent	63	127	49.6	14,348	20,602	69.6
Very good/good	352	776	45.4	57,920	93,608	61.9
Fair/poor	129	357	36.1	7,685	15,531	49.5
Missing	24	69	34.8	1,892	3,800	49.8

a See methods