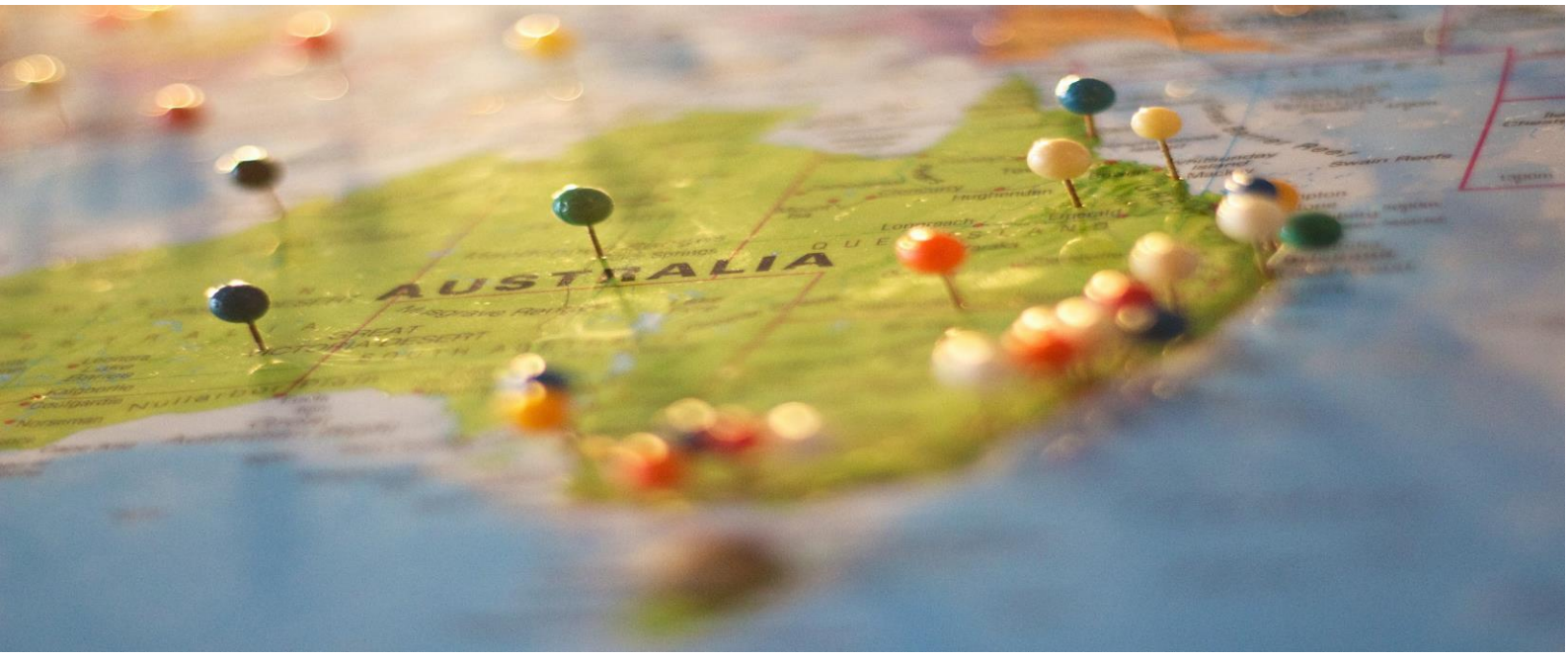
Socio-demographic Characteristics of Telephone Access in Australia: Implications for Survey Research

October 2019



Social Research Centre

Report prepared by:

Dr Benjamin Phillips

Jack Barton

Darren Pennay

Dr Dina Neiger

The Social Research Centre

Level 9, 277 William Street

MELBOURNE VIC 3000

Australia

Tel: +61 3 9236 8500

Fax: +61 3 9602 5422

Email: benjamin.phillips@srcentre.com.au

www.srcentre.com.au

Version: 25 October 2019

Contents

List of figures

List of tables

Authors

Benjamin Phillips is Senior Research Director, Survey Methodology at the Social Research Centre (SRC) and a Campus Visitor at the Centre for Social Research & Methods (CSRM), Research School of Social Sciences, College of Arts & Social Sciences, Australian National University.

Darren Pennay is Founder of the SRC and Executive Director of Research, Methods, and Strategy; a Campus Visitor at CSRM; and an Adjunct Professor with the Institute for Social Science Research, University of Queensland.

Dina Neiger is Chief Statistician at the SRC and a Campus Visitor at CSRM.

Jack Barton is an Analyst at the SRC.

Acknowledgements

We gratefully acknowledge the Australian Bureau of Statistics (ABS) for including questions on telephone status in the National Health Survey (NHS) 2017-18. This report would not have been possible without the foresight of the ABS in asking these questions.

We also acknowledge the generosity of the ABS Data Integration Partnerships Branch in making available the NHS 2017-18 in the Restricted Access DataLab for this analysis, with particular thanks to Talei Parker, Assistant Director, Customised and Microdata Delivery Section and Kim McCosker and Barry Tynan, also of the Customised and Microdata Delivery Section.

Thanks are also due to Peter Radisich, Assistant Director, Household Statistics Methodology at ABS for providing additional information on the NHS sample and weighting designs.

We also acknowledge the role played by the Australian Media and Communications Authority (ACMA) for its annual updates on telephone status in its *Communications Reports*. These reports provide vital information about telephony status in Australia and are an important source of information for Australian polling, social and market researchers.

Findings based on use of ABS Microdata:

> Australian Bureau of Statistics. 2017-18 *National Health Survey*. Microdata type: Detailed Microdata. Method of Access: DataLab.

Executive Summary

The National Health Survey (NHS) 2017-18, undertaken by the Australian Bureau of Statistics (2019a), included questions on the telephone status of Australian adults (landline-only, mobile-only, dual-users and no telephone). The collection of these data has enabled a comprehensive analysis of access to landline and mobile phones across Australia, and the geographic, socio-demographic and health characteristics associated with telephone usage – whether that be a landline phone, a mobile phone, neither or both.

Commercial entities, government, academia and the not-for-profit sector use telephone surveys to provide vital information across a range of health, social policy and commercial domains. The changing nature of Australians' telephone usage enables us to consider access to the telephone, and type of telephone, as a social equity issue and to explore the socio-demographic characteristics of telephone use. Taking proper account of the telephony status of the population is also important for high-quality telephone surveys and consequential for the commercial, social policy and public health statistics generated by telephone surveys. If the accuracy of telephone surveys is sub-optimal, there are real world implications – including for the Australian polling industry.

Overall, 2.0% of adults are estimated not to have a telephone (do not have a personal mobile phone and live in a household without landline service), 52.8% of adults are dual-users (they have a personal mobile phone and live in a household with landline service), 40.6% of adults are mobile-only (they have a personal mobile phone and live in a household without landline service) and 4.6% of adults are landline-only (they do not have a personal mobile phone and live in a household with landline service). As the number of persons with landline services has declined, the proportion of the adult population with a telephone number listed in White Pages has also diminished. Only 31.2% of adults report being listed in the White Pages and another 9.3% do not know if they are listed.

There are meaningful variations in telephone status by geography. The Northern Territory is notable for the large proportion of adults without telephone service (7.0%) and the very limited number of landline telephones (only 32.1% of NT adults live in landline households). Across the country, dual-users are more common in the least disadvantaged areas, while more disadvantaged areas have higher proportions of mobile-only, landline-only and no phone households.

Age is perhaps the most powerful predictor of telephone status, with mobile access being near universal through to age 64. Education is also strongly associated with telephone status – adults with higher levels of education are more likely to be mobile-only, while adults with less than Year 12 education are particularly likely to be landline-only.

Indigenous adults are also far more likely to be mobile-only and far less likely to be dual-users, and migrants who arrived in Australia from 2015 onwards are particularly likely to be mobile-only.

Employed adults are more likely to be mobile-only and less likely to be dual-users or landline-only than those who are unemployed or not in the labour force, although these effects dissipate almost entirely when other variables are controlled for.

Regarding household-level characteristics, family composition and household income are predictors of telephone status. One-person households are particularly likely to be mobile-only, while families with children are more likely to be dual-users. Higher levels of household income are associated with greater likelihood of being dual-users. Household tenure is very strongly tied to telephone usage at the bivariate level, with renters being particularly likely to be mobile-only and homeowners without mortgages having the highest levels of being dual-users or landline-only (the effect of tenure, however, ceases entirely when other variables are controlled for).

As a health survey, NHS also contains a wealth of variables measuring health conditions and risk factors. Risk factors associated with telephone status include: body-mass index, fruit and vegetable consumption, hypertension, physical activity, smoking, alcohol use, disability status, psychological distress and self-assessed health.

Even after controls for other variables, smokers are more likely to be mobile-only than either ex-smokers or those who never smoked, as are those who exceed either lifetime or short-term alcohol risk guidelines. This finding is consistent with literature both in Australia and overseas.

Indeed, the Australian literature on the mobile-only population from earlier this decade paints an interesting picture. For example, the mobile-only population is less likely to be overweight or obese and more likely to be physically active. They are also more likely to consume alcohol to harmful levels, to binge brink and to consume alcohol with energy drinks. Higher levels of illegal drug use have also been found to be associated with being mobile-only, as have higher levels of psychological distress, lower levels of mental health and higher levels of anxiety and depression. Problem gambling rates have been found to be higher among the mobile-only population, as has gambling on horses and greyhounds, casino table games and sporting events (overall rates of gambling, however, are not higher). Members of the mobile-only population have also been found to be more likely to have been a victim of crime or suffered financial hardship in the last 12 months. They are also more likely to have had two or more sexual partners in the last year.

Based on our review, we believe that telephone surveys that only use landline telephone numbers as a means of contacting and interviewing participants are not viable. This is due to the manifest coverage error in terms of under-coverage in general, and differential under-coverage of specific groups (such as younger adults, non-English speakers, recent migrants, one-person households and current smokers) and individuals with specific lifestyle and health behavioural risk factors. White Pages samples are prone to even larger coverage error with—at best—40.5% of the adult population being accessible via a directory listed number (31.2% know they are listed, 9.3% unknown listing status).

In contrast, telephone surveys that rely on mobile phones for contacting and interviewing participants have little in the way of coverage error due to the small number of landline-only adults.

Surveys using both landline and mobile phone numbers for contacting and interviewing participants (i.e., dual-frame random digit dialling [RDD] surveys) are necessary only if standalone estimates for adults age 75 and above (who are mainly reached via landline) are important to the research question/s of interest.

Because Australian mobile numbers are not associated with geography, the declining coverage of the landline frame means difficult choices must be made when conducting sub-national telephone surveys. If randomly generated mobile phone numbers are used, then these surveys incur very high costs due to the need to dial many, many numbers in order to identify sample members who reside within the geographic area of interest. Alternatively, if RDD mobile sample is not used, the very high coverage errors associated with calling landlines are the result. Recent changes to regulations that enable survey researchers to access mobile phone numbers and their associated postcode from the Integrated Public Number Database (IPND) open up new possibilities for some categories of telephone surveys (specifically those associated with population health, Commonwealth public policy and electoral matters). While a promising development, these regulatory changes are new, procedures for access are yet to be fully determined and the accuracy and productivity of IPND sample is yet to be tested.

Attractive alternatives to general community telephone surveys are emerging – including surveys using address-based sampling approaches and probability-based online panels in the form of Life in Australia™, Australia's only such panel.

Finally, we draw attention to the implications of this paper for survey research in the Northern Territory. The NT has an exceptionally high proportion of its adult population in non-telephone households (7.0%)—and even this estimate is, in all likelihood, too low because the NHS excludes very remote areas that hold 19.9% of the NT population. If that were not enough of a handicap, the fact that the NT has the lowest landline coverage *and* less than 1% incidence in the mobile frame means that it is virtually impossible to obtain representative telephone samples. In our view, these factors suggest that special measures are required to provide high quality data on the NT population that can be used in the formulation of government policy, such as omnibus household surveys to collect data for official statistics that would ordinarily be covered by separate data collection efforts.

1. Introduction

The Australian Bureau of Statistics (ABS) is to be commended for including questions on landline and mobile phone access in the National Health Survey (NHS) 2017-18 (ABS 2019). The inclusion of these questions has enabled, for the first time, a comprehensive analysis of landline and mobile phone usage across Australia and the geographic, demographic and health characteristics associated with having or not having access to a telephone (whether that be a landline phone, a mobile phone, neither or both). This is the first time detailed information has been available on the correlates of telephone usage in Australia. The availability of these data provides Australian social scientists and survey researchers with a report that is comparable in nature to the U.S. National Center for Health Statistics' bi-annual report *Wireless Substitution: Early Release of Estimates from the National Health Interview Survey* (Blumberg & Luke 2007, 2019).[1] Since 2007, the *Wireless Substitution* reports have provided a regularly updated and authoritative source of information on the increasing proportion of the U.S. population reachable only via mobile phone ('wireless' in the report's phrasing). The content of these reports drove the rapid development of methods in the U.S. for surveying mobile phones and weighting dual-frame random digit dialling surveys.[2] As we discuss below, telephone surveys are important sources of data on Australians. The changing nature of Australians' telephone use enables us to consider access to the telephone, and type of telephone, as a social equity issue, and to explore the sociographic characteristics of telephone access. Taking proper account of the telephony status of the population is important for high-quality telephone surveys and consequential for the social policy and public health statistics generated by telephone surveys. As a result, telephone use is a subject of more than mere academic importance – there are important implications in this report for the Australian polling industry at large.

1.1. Importance of telephone research in Australia

Telephone surveys currently provide important information about Australians. Telephone surveys with real-world consequences include the following:

- State-level population health surveys providing information on health conditions and risk factors of Australians
- The National Visitor Survey, which continuously tracks domestic tourism and tourism spending, and forms part of the Tourism Satellite Account in the Australian system of national accounts
- The National Survey of Community Satisfaction with Policing, which tracks satisfaction with policing services and feelings of public safety
- The AusPlay survey, which continuously tracks Australian participation in sport and physical activity
- Recreational fishing surveys, which provide information on fishing catch by species and feed into fisheries management

[1] The NHS 2014-15 included items on telephone use, but the resulting estimates did not comport with ACMA estimates. As we show on p. 4, the ACMA and ABS estimates closely mirror each other.
[2] Early papers on sampling and other methodological matters include AAPOR (2010), Boyle, Lewis & Tefft (2010), Brick et al. (2006, 2007), Brick, Edwards & Lee (2007), Callegaro et al. (2007), Dutwin et al. (2008), Frankel et al. (2007), Guterbock et al. (2011), Ivie et al. (2006), Kennedy (2007), Lavrakas et al. (2007) and Link et al. (2007). Early papers on weighting include Best (2010), Brick et al. (2011), Callegaro et al. (2011) and Wolter, Smith & Blumberg (2010).

- Political polling and other surveys of public opinion that shape our understanding of Australian society.

Appendix A provides a partial list of consequential telephone surveys.

1.2. Organisation of the report

Section 2 reviews previous research on telephone use.

Section 3 summarises the relevant methodological characteristics of the NHS.

Section 4 describes the overall level of telephone status, compares it to Australia's other primary source of telephone status estimates (the annual Australian Communications and Media Authority [ACMA] Communications Report [ACMA 2019a]) and assesses the adequacy of listed telephone numbers as a sampling frame for telephone surveys.

Section 5 describes variation in telephone status by geography, including states and territories, capital city and rest of state, remoteness, and the socio-economic status of an area.

Section 6 looks at the relationship between various demographic characteristics and telephone use. These include age, gender, education, migrant status, language, employment status and family status.

Section 7 takes advantage of the health information available in the NHS to look at variations in health conditions and health risk factors. These include body-mass index, fruit and vegetable consumption, hypertension, physical activity, smoking, alcohol use, disability status, psychological distress and self-assessed health.

Section 8 describes variations in telephone status by the household characteristics of family composition, tenure type and household income.

Section 9 models telephone status, mobile access and landline access.

Section 10 discusses the findings and their implications for Australian survey research.

1.3. Definition of telephone status

Throughout the report, we focus on telephone status: whether adults and households have landline and mobile telephones that can receive incoming calls, as the ability to receive incoming calls is what telephone surveys rely on. We do not examine whether telephones are used for outbound calls. The questions used to derive telephone status are provided in Appendix B.

2. Previous Research

This section summarises research from Australia and overseas. We begin our review by providing detail on prior research conducted in Australia, before turning to the factors associated with telephone use, organised in a similar fashion to this report (e.g., geography, then demographics, etc.). While the predominant non-Australian source of data is the U.S, we also identified information on telephone use in Brazil, Finland, Lebanon, Portugal and Slovenia. Most of the international literature comes from the mid-2000s, when it became commonly recognised that the increasing mobile-only population was threatening the representativeness of telephone surveys, which had been conducted only on landline telephones to that point. Once dual-frame random digit dialling (RDD) surveys became the norm for telephone research, interest in the characteristics of different types of telephone use died away. In the U.S., key data on telephone use has been provided twice yearly by the National Health Interview Survey; with a high-quality, regularly updated series of estimates, there has been little reason for others to publish. Reflecting the main area of interest at the time, these studies typically compare mobile-only adults to landline-accessible adults.

2.1. Summary of prior research in Australia

The first test dual-frame RDD survey in Australia (calling both landlines and mobile phones) was conducted in September 2010 (n = 700) by Pennay (2010). Further to this, Dal Grande and Taylor (2010) used data from a face-to-face population health survey in South Australia to examine the characteristics of mobile-only adults, using data from surveys fielded in 2006 (n = 2,969), 2007 (n = 2,507) and 2008 (n = 2,824). Gruszin and Szuster (2010) analysed Roy Morgan household surveys conducted nationally from August 2001 to July 2003 and January 2006 to December 2007 (sample sizes are not reported). Liu et al. (2011) fielded a dual-frame RDD survey screening for women aged 18 to 39 in March 2011 (n = 268). Alexander et al. (2012) report results from a dual-frame RDD survey fielded in November and December 2011, screening for the Victorian population (n = 4,500). Barr et al. (2012) use results from the New South Wales Population Health Survey fielded in the first quarter of 2012 (n = 3,395); this dual-frame RDD survey screened for the NSW population. Livingstone et al. (2013) and Jackson et al. (2014) use data from the same national dual-frame RDD survey (n = 2,014) conducted in December 2011. Dowling et al. (2015) and Pennay et al. (2015) report results from the same national dual-frame RDD survey fielded March to April 2013 (n = 2,000). Baffour et al. (2016) base their report on the 2011-12 Australian Health Survey, which used face-to-face interviewing (15,565 households adequately responded to the survey with 20,426 persons interviewed) and was fielded March 2011 to March 2012. Badcock et al. (2017) report based on a national dual-frame RDD survey fielded in December 2011 (n = 2,014). Baffour et al. (2017) report based on the 2015 Queensland Preventative Health Survey, a list-based dual-frame survey (n = 12,568); exact field dates are not reported.

2.2. Geography

2.2.1. State

Australia

Baffour et al. (2016) found higher proportions of mobile-only population in Queensland, Western Australia and the Northern Territory and lower proportions in Victoria.

Other countries

Due to the large number of states in the U.S., states are grouped into regions for the purpose of analysis in most surveys. Residence in the Northeast was associated with the lowest likelihood of mobile-only status (Blumberg et al. 2007, 2019; Tucker et al. 2007).[3] Residence in the Midwest and South was associated with the highest likelihood of mobile-only status (Tucker, Brick & Meekins 2007; Peytchev et al. 2010), with this effect persisting after controls were introduced in Tucker et al. (2007). The definitive series of estimates from the National Health Interview Survey originally found only adults from the South having higher rates of mobile-only status than the Northeast (Blumberg & Luke 2007), but by 2018 the Midwest, South and West all had higher rates of being mobile-only than the Northeast (Blumberg & Luke 2019). Like the U.S., Brazil divides its states into regions. There was significant variation in telephone use by region, with mobile-only status highest in the North, followed by the Northeast, Midwest, South and Southeast (Bernal et al. 2017). In Portugal, there were no significant differences by region (Vicente & Reis 2009). In Lebanon, mobile access was higher in Beirut and lower in Bekaa and Nabatieh.

2.2.2. Capital city and rest of state or territory

Australia

Mobile use has been consistently reported to be more prevalent in capital cities. Pennay (2010) and Badcock et al. (2017) found mobile respondents were more likely to come from capital cities than the rest of the state. Similarly, Jackson et al. (2014) and Dowling et al. (2015) found higher levels of mobile-only populations in capital cities.

2.2.3. Area-level socio-economic status

Australia

Dal Grande and Taylor (2010) identify mobile-only adults as coming disproportionately from low socio-economic status areas (note that the sample for this study was limited to South Australia).

2.2.4. Urbanicity

Australia

Reports of the relationship between urbanicity and telephone use are mixed. Dal Grande and Taylor (2010) report (using South Australian data) that mobile-only adults were more likely to come from rural areas. Livingston et al. (2013), however, found slightly higher rates of 'metro' region residence for the mobile sample. Baffour et al. (2016) found no significant differences in urbanicity by telephone use.

Other countries

In the U.S., metropolitan status was associated with higher rates of mobile-only status in 2006, but by 2018 the differences were no longer significant (Blumberg & Luke 2007, 2019). In Finland, mobile-only status was more common in urban areas (Kuusela et al. 2008). The finding of higher mobile access in Beirut mentioned above suggests that a similar pattern may exist in Lebanon.

[3] The National Center for Health Statistics produces two estimates per year of the characteristics of 'wireless-only' households in the U.S. We refer to only the earliest (Blumberg & Luke 2007) and—as of time of writing—most recent (Blumberg & Luke 2019) of this series in this literature review. Where appropriate, we comment on changes in factors associated with telephone use.

2.3. Demographics

2.3.1. Age

Australia

Younger age is invariably found to be associated with mobile use. Pennay (2010) found significantly higher representation of adults aged 18-34 and lower representation of adults aged 55+ in unweighted mobile sample compared to landline sample; the mobile-only sample was particularly young, while the landline sample was particularly old. Dal Grande and Taylor (2010) also identified younger adults as more likely to be mobile-only than older adults. Barr et al. (2012) found younger adults are more common on the mobile frame and among the mobile-only population than older adults. Gruszin and Szuster (2010) reported 18-24 year-olds were particularly unlikely to have landline service and Badcock et al. (2017) found higher rates of 18-39 year-olds among the mobile-only population and higher rates of 18-24 year-olds among mobile users as a whole. Livingston et al. (2013) and Dowling et al. (2015) similarly found higher representation of 18-39 year-olds on the mobile frame than the landline frame, and lower levels of 65+ year-olds on the mobile frame compared to the landline frame – the results for mobile-only respondents tended to be even more pronounced. Jackson et al. (2014) and Baffour et al. (2016, 2017) found mobile-only respondents were more likely to be aged 18-34.

Other countries

Mobile use is also strongly linked to age in the U.S., Brazil, Finland, Lebanon and Portugal, with Slovenia being an outlier. In the U.S., mobile-only respondents were much younger than those reachable via landline (Blumberg & Luke 2007, 2019; Link et al. 2007; Kohut et al. 2008; Peytchev et al. 2010), although Blumberg & Luke (2019) noted increasing rates of mobile-only use among adults aged 45 and above. Blumberg & Luke (2019) report that 18-24 year-olds have lower levels of being mobile-only than 25-34 year-olds, a phenomenon that we will show is replicated in NHS 2017-18. Tucker et al. (2007) found mobile-only status to be negatively associated with age, controlling for other factors. Brazil (Bernal et al. 2017), Finland (Kuusela, Callegaro and Vehovar 2006), Japan (Saito & Lavrakas 2015) and Lebanon (Sibai et al. 2016) exhibited the same negative correlation between age and mobile-only status. Portugal also exhibited a negative correlation between mobile-only status and age, with the exception of 15-24 year-olds, who were slightly less likely to be mobile-only than were 25-34 year-olds (Vicente & Reis 2009). Slovenia, however, had peak mobile-only status among 35-44 year-olds with lower levels of mobile-only status for older and younger adults (Vehovar et al. 2004).

2.3.2. Gender

Australia

Male gender is consistently associated with higher rates of mobile use. Pennay (2010), Livingston et al. (2013), Jackson et al. (2014), Dowling et al. (2015), Baffour et al. (2016, 2017) and Badcock et al. (2017) identified larger proportions of males on mobile RDD sample compared to landline RDD sample and even higher proportions of males among mobile-only adults in unweighted sample.

Other countries

In the U.S., males were more likely to be mobile-only in 2006 (Blumberg & Luke 2007) but gender differences had ceased to be significant by 2018 (Blumberg & Luke 2019). In Lebanon, males were over-represented among mobile users (Sibai et al. 2016).

2.3.3. Education

Australia

The reported relationship between education and telephone use is mixed. Pennay (2010) and Baffour et al. (2016) found no significant differences between the educational profiles of mobile and landline respondents. However, Pennay (2010) identified mobile respondents as being much more likely to be currently enrolled in post-secondary education, particularly mobile-only, a finding replicated by Jackson et al. (2014). Dal Grande and Taylor (2010) identified mobile-only adults as being more likely to have completed at least secondary school. Badcock et al. (2017) found mobile-only respondents were more likely to have completed over 12 years of education. Livingston et al. (2013) and Dowling et al. (2015) found higher levels of education among mobile respondents. Baffour et al. (2016) found no differences in having a Bachelor's degree or higher across mobile-only and landline-accessible adults.

Other countries

Brazil (Bernal et al. 2017) and the U.S. (Link et al. 2007; Tucker et al. 2007; Kohut et al. 2008) exhibit a strikingly different education profile to findings from Australia, with mobile-only respondents consistently tending to be less educated than adults reachable via landline. Mobile-only respondents in the U.S. are also more likely to be students (Link et al. 2007). In Slovenia, mobile-only status was highest for adults with vocational education and lower for adults with only elementary education, secondary education and tertiary education (Vehovar et al. 2004). In Portugal, the group most likely to be mobile-only were those with primary education; those with no formal education or secondary education or vocational training did not differ from those with university education (Vicente & Reis 2009). In Lebanon, mobile use was higher among adults with higher levels of education (Sibai et al. 2016).

2.3.4. Indigenous status

Australia

Indigenous status is linked to mobile use, particularly being accessible only via mobile phone. Pennay (2010) found higher levels of Indigenous adults in mobile sample than landline sample. Indigenous adults were particularly likely to be mobile-only, a finding shared by Liu et al. (2011), Barr et al. (2012) and Jackson et al. (2014).

2.3.5. Migrant status

Australia

There is a high degree of agreement on linking mobile use with being a migrant. Pennay (2010), Barr et al. (2012), Jackson et al. (2014) and Badcock et al. (2017) found higher levels of adults not born in Australia in mobile sample than for landline sample; migrants were particularly likely to be mobile-only. By contrast, Dal Grande and Taylor (2010) identify adults born in Australia as being more likely to be mobile-only in their South Australian sample.

2.3.6. Race and ethnicity

Although race and ethnicity are not commonly employed as demographic categories in Australia, they are a major feature of social scientific analysis in the U.S. Their use is justified by the pervasive differences in socio-economic outcomes and the legacy of discrimination that drives them.

Other countries

Mobile-only adults in the U.S. are more likely Hispanic than landline-accessible adults (Blumberg & Luke 2007, 2019; Link et al. 2007; Kohut et al. 2008; Peytchev et al. 2010). Some studies have found higher prevalence of mobile-only status among black Americans (Kohut et al. 2008; Peytchev et al. 2010), although the definitive series of estimates from the National Health Interview Survey does not share these findings (Blumberg & Luke 2007, 2019). Kohut et al. (2008) also found higher levels of Asians among landline-accessible adults. Tucker et al. (2007) are an exception, finding whites were more likely to be mobile-only, controlling for other factors. Controlling for variables seems to be key to the apparent disjunction, as tabulations by the same authors show higher levels of mobile-only status for blacks and Hispanics, indicating the correlates of being black or Hispanic rather than race or ethnicity itself was the driving factor.

2.3.7. Employment status

Australia

Some disagreement exists regarding the relationship between employment status and telephone use. Pennay (2010) and Jackson et al. (2012) reported mobile respondents were more likely to be employed than landline respondents. By contrast, Dal Grande and Taylor (2010) found unemployed adults were more likely to be mobile-only, using South Australian data.

Other countries

There is also disagreement in the U.S. Tucker et al. (2007) reported mobile-only respondents were less likely to be unemployed while Link et al. (2007) found mobile-only respondents were more likely to be out of work. More recently in the U.S., mobile-only status was most common for adults who were working at a job or business or ‘keeping house’ (to use the term reported), intermediate for students and lowest for all other statuses including the unemployed (Blumberg & Luke 2019). In Portugal, adults in the labour force and ‘housewives’ (to use the term reported) were all significantly more likely to be mobile-only than those not in the labour force (Vicente & Reis 2009). In Lebanon, adults with mobile access were under-represented among those who were not working (Sibai et al. 2016).

2.3.8. Marital status

Australia

Mobile-only respondents appear to be less likely to be married or in relationships than dual-users. Dal Grande and Taylor (2010) reported that mobile-only respondents were particularly likely to be separated, divorced or never married in their South Australian survey. Using NSW data, Barr et al. (2012) found mobile-only respondents were more likely to be single. Dual-users interviewed on the mobile frame were, however, the most likely to be married. Badcock et al. (2017) found dual-users were more likely to be married than either mobile- or landline-only.

Other countries

Mobile-only adults in the U.S. were also less likely to be married (Link et al. 2007; Tucker et al. 2007; Kohut et al. 2008).

2.4. Health conditions and risk factors

2.4.1. Body-mass index

Australia

Mobile-only adults are generally found to be more likely to be of normal weight than those accessible via landline frame. Dal Grande and Taylor (2010) and Baffour et al. (2016, 2017) found mobile-only adults were more likely to have normal body-mass index, although when Baffour et al. (2017) introduced controls for age, the relationship ceased to be significant. Gruszin and Szuster (2010) similarly found that adults of 'acceptable weight' were less likely to have landline access.

Other countries

In 2006 in the U.S., mobile-only adults were less likely to be obese (Blumberg & Luke 2007) but by 2018 there was no longer a significant difference in obesity (Blumberg & Luke 2019). In Lebanon, obesity was lower for adults with mobile access (Sibai et al. 2016).

2.4.2. Physical activity

Australia

Two studies identified mobile-only status being associated with higher levels of physical activity. Baffour et al. (2016) found higher proportions of the mobile-only population met the guidelines of spending more than 150 minutes on physical activity a week. Similarly, Baffour et al. (2017) found a higher proportion of mobile-only respondents had engaged in sufficient physical activity, although the relationship ceased to be significant for the weighted sample when age was controlled for.

Other countries

Mobile-only adults in the U.S. were more likely to have met physical activity guidelines for aerobic activity based on leisure-time activity (Blumberg & Luke 2019).

2.4.3. Hypertension

Other countries

Mobile access was associated with lower rates of hypertension in Lebanon (Sibai et al. 2016).

2.4.4. Smoking

Australia

Smoking is consistently identified as being associated with mobile-only status. Pennay (2010) and Livingston et al. (2013) found significantly higher rates of smoking among mobile-only than landline respondents. Smoking was a predictor of mobile-only status even after controlling for other factors (Pennay 2010). Similarly, Dowling et al. (2015) reported higher levels of daily smoking for mobile respondents than those reached via landline. Dal Grande and Taylor (2010), Gruszin and Szuster (2010) and Baffour et al. (2016, 2017) found current smokers were more likely to be mobile-only than landline-accessible. This relationship persisted after age was controlled for in Baffour et al. (2017) (other sources cited did not report results after age controls). Alexander et al. (2012) reported slightly higher regular smoking rates for dual-frame RDD than single frame landline RDD in their Victorian survey.

Other countries

Mobile-only status in the U.S. is also associated with higher rates of smoking (Blumberg & Luke 2007, 2019). Cigarette smoking did not vary by mobile access in Lebanon, although water pipe smoking was higher for adults with mobile access (Sibai et al. 2016).

2.4.5. Alcohol use

Australia

Harmful levels of alcohol use are consistently reported for mobile-only adults. Pennay (2010) reported mobile-only respondents had higher levels of harmful alcohol consumption (ever had 4+ standard drinks [women] / 6+ standard drinks [men] in a day) and binge drinking (ever had 20+ standard drinks in a session) than landline respondents. Livingston et al. (2013) reached similar conclusions, with higher rates of risky (5+ standard drinks) and very risky (11+ standard drinks) for mobile and mobile-only respondents than landline, although no differences were identified with overall rates of drinking or alcohol consumption. After controls for age, sex, location and education were introduced, mobile-only status was not a predictor for either risky or very risky drinking. Jackson et al. (2014) also found higher levels of hazardous drinking among mobile-only sample and Dowling et al. (2015) reported higher rates of binge drinking for mobile-only respondents. Baffour et al. (2017) found increased rates of high risk drinking for mobile-only respondents, with the relationship persisting when age was controlled for.

Other countries

The association with mobile use and alcohol use persists outside of Australia. Link et al. (2007) found higher rates of binge drinking in the past 30 days for mobile-only respondents. Similarly, Blumberg and Luke (2007, 2019) reported higher rates of binge drinking among mobile-only adults. Lebanon also conforms to this pattern, with binge drinking in the past 30 days being higher for adults with mobile access (Sibai et al. 2016).

2.4.6. Energy drink use

Australia

Mobile respondents were more likely to report using energy drinks than landline respondents (Pennay et al. 2015). Pre-mixed alcohol and energy drink consumption was also higher for mobile users (Pennay et al. 2015).

2.4.7. Use of illegal drugs

Australia

Pennay (2010) identified far higher rates of using illegal drugs among mobile-only respondents than landline respondents; illegal drug use was a predictor of mobile-only status, controlling for other factors. Similarly, Livingston et al. (2013) found higher recent and lifetime cannabis use for mobile respondents.

2.4.8. Psychological distress

Australia

There is some evidence for higher levels of psychological distress and lower levels of mental health for mobile-only sample. Jackson et al. (2014) reported higher levels of anxiety and depression among mobile respondents than landline respondents. Dowling et al. (2015) identified mobile respondents as

less likely to report low psychological distress. Baffour et al. (2016) found higher incidence of psychological distress and poorer mental health in the mobile-only population. Pennay (2010) did not find any significant differences in feeling downhearted or sad most or all the time between mobile-only and landline respondents, although mobile respondents were, in nominal terms, more likely to report distress.

Other countries

Confidence intervals for experiencing serious psychological distress in the past 30 days overlapped between mobile-only and landline-accessible adults (Blumberg & Luke 2006), but by 2018 were distinct (Blumberg & Luke 2019).

2.4.9. Self-assessed health

Australia

Mobile-only status may be associated with higher levels of self-assessed health. Dowling et al. (2015) found mobile respondents were more likely to report excellent/good health compared to landline respondents. Pennay (2010) found no significant differences in self-assessed health between mobile-only and landline respondents, although—in nominal terms—landline respondents were more likely to report being in excellent or very good health.

Other countries

In the U.S., mobile-only status was associated with higher rates of reporting excellent or very good health (Blumberg & Luke 2007, 2019). Similarly, mobile access in Lebanon was associated with higher rates of reporting very good or better health (Sibai et al. 2016).

2.4.10. Problem gambling

Australia

Problem gambling appears to be higher for mobile-only respondents, although overall gambling rates may not differ. Pennay (2010) reported finding significantly higher rates of problem gambling (ever had an issue with your gambling) among mobile-only respondents than landline respondents; problem gambling was a predictor of mobile-only status. Dowling et al. (2015) found higher rates of gambling on horse or greyhound races, casino table games, sporting events, private games, the internet and electronic gaming machines than landline respondents. They also had higher rates of problem gambling and were more likely to endorse several Problem Gambling Score Index items. However, they were found less likely to gamble on lotteries. Jackson et al. (2014) found lower gambling participation over the past 12 months and lower regular gambling for mobile-only adults than among adults reachable via landline, but mobile-only adults were more likely to endorse items on a problem gambling measure.

2.4.11. Sexual behaviour

Australia

Badcock et al. (2017) found higher proportions of mobile phone respondents reported having two or more sexual partners in the past year than did landline respondents, although the relationship between telephone status and number of partners did not persist after controlling for demographic factors. Badcock et al. (2017) also found higher levels of previous same-sex sexual experience for

female (but not male) mobile-only respondents; but again, telephone use ceased to be a significant predictor when demographics were controlled for.

2.4.12. Social support

Australia

Mobile-only respondents had lower levels of social support than landline respondents on 2 out of 4 measures tested by Pennay (2010): help from neighbours when needed and help from friends when needed. There were no differences on help from family members when needed or having a relative of friend care for you or your children in an emergency.

2.4.13. Victimisation

Australia

Mobile-only respondents were more likely to report being a victim of a house break-in or burglary than landline respondents, and were more likely to report being a victim of physical assault or robbery (Pennay 2010). Controlling for other factors, however, victimisation was not a predictor of being mobile-only. There were, however, no significant differences in rates of feeling safe walking down the street after dark (Pennay 2010).

Other countries

In the U.S., women who were mobile-only were more likely to report having experienced psychological aggression on a yes/no item than women who were landline-accessible (Peytchev et al. 2010). Men who were mobile-only were more likely than men who were landline accessible to report being a victim of sexual violence and scored higher on a scale of psychological aggression (Peytchev et al. 2010).

2.4.14. Discrimination

Australia

Mobile-only respondents were more likely to report ever having experienced discrimination in Australia because of their national or ethnic background or religion (Pennay 2010).

2.4.15. Asthma

Australia

Dal Grande and Taylor (2010) found higher levels of asthma among mobile-only adults in South Australian data.

Other countries

Confidence intervals for having experienced an asthma episode in the past year overlapped between mobile-only and landline accessible adults in the U.S. (Blumberg & Luke 2007, 2019). There was also no relationship between mobile access and asthma in Lebanon (Sibai et al. 2016).

2.4.16. Diabetes

Other countries

Diabetes was lower among mobile-only adults in the U.S. (Blumberg & Luke 2007, 2019) and for adults with mobile access in Lebanon (Sibai et al. 2016).

2.4.17. Influenza vaccination

Other countries

Mobile-only adults in the U.S. were less likely to have received an influenza vaccination in the previous year (Blumberg & Luke 2007, 2019).

2.4.18. HIV testing

Other countries

HIV testing was more prevalent among mobile-only adults in the U.S. than other adults with landline access (Blumberg & Luke 2007, 2019).

2.4.19. Health insurance

Australia

Baffour et al. (2016) reported lower rates of having private health insurance among the mobile-only population than those accessible via landline.

Other countries

In the U.S., mobile respondents were found to be less likely to have any health care coverage (Blumberg et al. 2007, 2019; Link et al. 2007) and more likely to have not received needed health care due to cost (Blumberg et al. 2007, 2019; Link et al. 2007). In Lebanon, the opposite pattern prevailed, with mobile users being disproportionately likely to have insurance coverage (Sibai et al. 2016).

2.5. Household characteristics

2.5.1. Family composition

Australia

Mobile respondents have been identified as more likely to live in group households and mobile-only adults as more likely to live with their parents. Pennay (2010), Jackson et al. (2014) and Dowling et al. (2015) found group households much more prevalent among mobile respondents than among landline respondents. Badcock et al. (2017) found higher rates of living in 'shared households' for those who were mobile-only, as did Jackson et al. (2014) and Dowling et al. (2015). Liu et al.'s (2011) survey of young women found that mobile respondents were more likely to live with their parents; those reached on mobile were also likely to have ever been pregnant. Dowling et al. (2015) also found that people reached via mobile phone were more likely to live with their parents.

Other countries

Mobile-only adults in the U.S. were less likely to have children in their household than other adults (Tucker et al. 2007). Mobile-only adults in the U.S. were particularly likely to live with unrelated adult roommates (Blumberg & Luke 2019), similar to Australian findings. In Finland, single-adult households were the most likely to be mobile-only (Kuusela et al. 2008). In Portugal, single adults living alone and other types of family (group households and multi-generational families) were the most likely to be mobile-only, while single adults living with their parents were the group least likely to be mobile-only; married families with and without children and single parents occupied a middle place (Vicente & Reis 2009).

2.5.2. Household tenure

Australia

Mobile respondents have been found to be more likely to be renters than landline respondents and have lower likelihood of having lived in their current neighbourhood for at least 5 years. Pennay (2010) found far higher rates of renting among mobile respondents than from the landline frame, and mobile-only respondents were particularly likely to be renters. Jackson et al. (2014), Dowling et al. (2015) and Baffour et al. (2016) also found the mobile-only sample were more likely to be renters, with Baffour et al. (2016) also finding an under-representation of home owners among mobile-only respondents. Mobile respondents were also less likely to have spent more than 5 years in their current neighbourhood, with mobile-only respondents particularly unlikely to have extended residence in their current neighbourhood (Pennay 2010; Jackson et al. 2014; Dowling et al. 2015).

Other countries

Mobile-only respondents in the U.S. were less likely to live in owner-occupied dwellings (Tucker et al. 2007). Mobile-only adults in the U.S. were more likely to live in rented homes (Blumberg & Luke 2019). The link between renting and mobile-only status also held for Finland (Kuusela et al. 2008). In Lebanon, mobile access did not vary by household tenure (Sibai et al. 2016).

2.5.3. Household income

Australia

The economic picture that emerges from previous research is mixed. Dal Grande & Taylor (2010) reported mobile-only adults were more likely to come from low-income households (less than $80,000 per year) than higher income households in research in South Australia. Barr et al. (2012) found no significant differences in income between mobile-only and landline respondents, but did find higher levels of income for mobile respondents as a whole than landline respondents for NSW. Dowling et al. (2015) identified mobile respondents as being more likely to earn $60,000 to $100,000 and less likely to earn less than $60,000 compared to landline respondents.

Other countries

U.S. studies find consistently lower levels of household income among the mobile-only population (Kohut et al. 2008). Similar patterns were observed in Finland (Kuusela at al 2008).

2.5.4. Financial hardship

Australia

Financial hardship was more common among mobile-only respondents than landline respondents. Mobile-only respondents had higher levels of not being able to make rent or mortgage payments on time, food insecurity, needing financial assistance from a welfare or community agency and being unable to raise $2,000 in 2 days in an emergency (Pennay 2010). Being unable to raise money in an emergency was a predictor of mobile status, controlling for other factors (Pennay 2010).

Other countries

Adults in the U.S. living in poverty and near poverty were more likely to be living in mobile-only households (Blumberg & Luke 2007, 2019), although this relationship weakened over time as a greater proportion of the population became mobile-only (Blumberg & Luke 2019).

2.6. Attitudes, behaviours and knowledge

2.6.1. Attitudes

Australia

Pennay (2010) found no significant differences in attitudes to the level of immigration to Australia or attitude to the environment across mobile and landline respondents, or reports about whether the respondent's neighbourhood is a place where people of different backgrounds get on together.

Other countries

Mobile-only respondents were less likely to describe themselves as 'conservative' than landline-accessible adults in the U.S. (Keeter et al. 2007). Support for gay marriage was higher for mobile-only respondents than landline-accessible adults in the U.S., while support for then-President Bush was lower (Keeter et al. 2007). In a battery of issues important to their vote, registered voters who were mobile-only were more likely to say immigration would be important to their vote and less likely to say that Social Security would be important to their vote than registered voters who were landline accessible (Kohut et al. 2008).

2.6.2. Political behaviour

Other countries

U.S. mobile-only respondents were much less likely to be registered to vote than landline-accessible adults and more likely to say they were too busy to vote (Keeter et al. 2007). When they voted, mobile-only respondents were less likely to report voting Republican (Keeter et al. 2007).

2.6.3. Knowledge

Other countries

In the U.S, awareness that the Republican Party held the majority of the House of Representatives was higher among landline-accessible than mobile-only adults (Keeter et al. 2007).

2.6.4. Media use

Other countries

Keeter et al. (2007) reported that mobile-only adults in the U.S. were less likely to report reading a newspaper than landline-accessible adults and were also less likely to report closely following the election campaign. Kohut et al. (2008) found that U.S. mobile-only respondents were less likely to rely on newspapers and network evening news for presidential election campaign information and more likely to get news on the campaign from the internet and late night comedy shows.

2.6.5. Internet use

Other countries

Kohut et al. (2008) found that American mobile-only respondents were more likely to use social networking sites.

3. Data

The NHS is conducted every three years. Although it is primarily intended to provide estimates of the prevalence of long-term health conditions, health risk factors (such as smoking, obesity, alcohol consumption and physical activity) and demographic and socio-economic characteristics, the 2017-18 questionnaire included questions on telephone status. A summary of the key methodological characteristics of the NHS is provided in Figure 1 below and more detailed information is provided in Appendix C.

Figure 1 Key methodological characteristics of the National Health Survey 2017-18

Characteristic	Description
In-scope population	Residents in private dwellings in all states and territories. Australian External Territories were not included nor were Very Remote Areas and discrete Aboriginal and Torres Strait Islander communities
Sample size	21,315 individuals residing in 16,384 households
Survey mode	Face-to-face interview
Sample design	Multi-stage area probability sample selection of households Random selection within households
Weights	The survey estimates are weighted to take account of each respondents' chance of being selected in the survey and then calibrated to population benchmarks by age, sex and usual residence.
Response rate	76.1%

Sources: ABS (2018a); Radisich (2019).

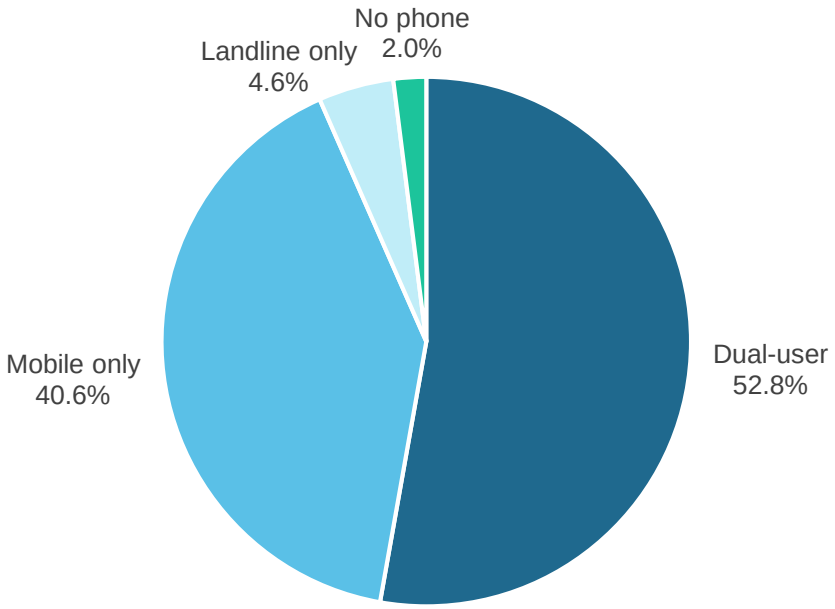
4. Telephone Status

In this section, we describe overall telephone status of the Australian adult population and compare the NHS estimates to the other authoritative source of estimates of telephone status in Australia—the Australian Communications and Media Authority (ACMA) Communications Report. We also use the NHS to understand the adequacy of the White Pages as a sampling frame, as there are still some Australian telephone surveys that rely solely on the White Pages (and others that use the White Pages as a starting point) for generating telephone numbers for survey research.

4.1. Adult telephone status

Telephone status estimates for adults from NHS are shown in Figure 2. Adults without telephone service make up 2.0% of the population. Adults living in landline households (i.e., dual-user + landline-only) make up 57.4% of the population. Adults with a mobile phone (i.e., dual-user + mobile-only) make up 93.4% of adults. The majority of adults have both a landline and mobile phone service (i.e., dual-users), although the mobile-only population is not far behind and—as is known from ACMA (2019a)—rapidly growing.

Figure 2 Adult telephone status



4.2. Comparison to the ACMA Communications Report

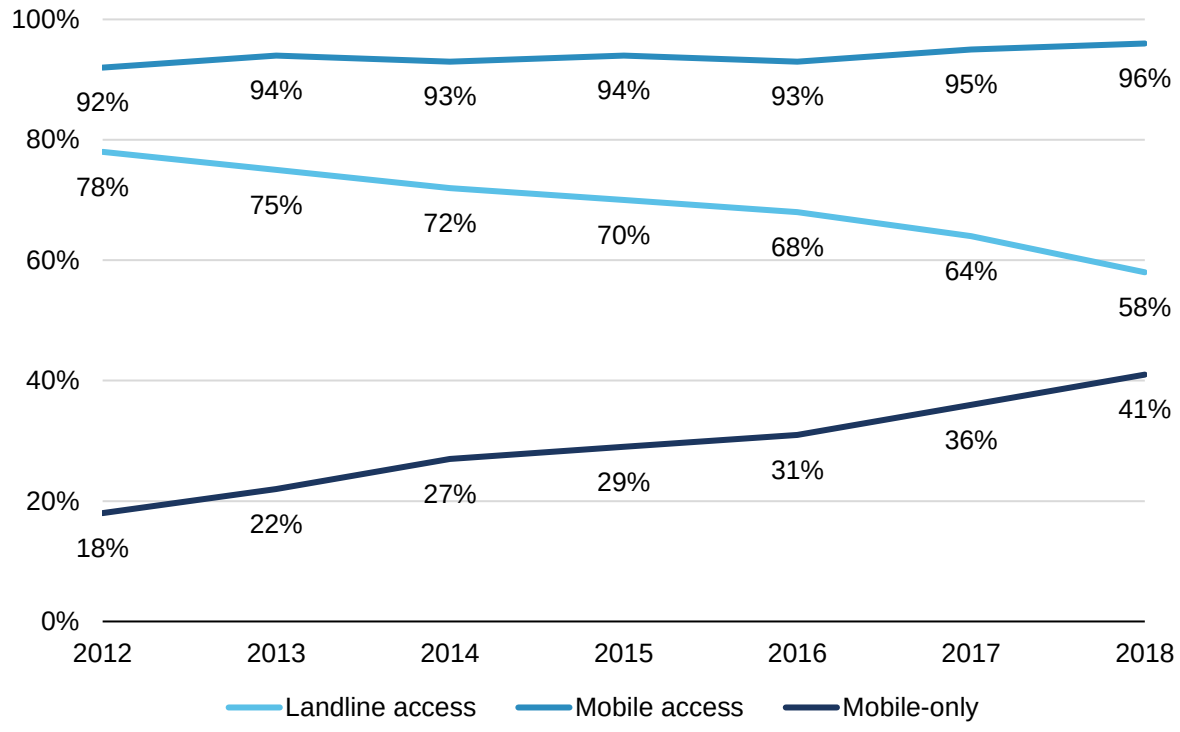
To date, the ACMA Communications Report (ACMA 2019a) has been the authoritative source on telephone usage in Australia. The ACMA collects landline usage data using Roy Morgan Single Source. Like the NHS, Single Source collects data using in-person interviewing. As expected, the estimates from NHS are very similar to ACMA (2019a). NHS estimates landline coverage at 57.4%, and the ACMA estimates 58%. We would also expect NHS estimates of mobile usage to be very similar to those from the ACMA report. The ACMA collects mobile usage data using Life in Australia™, a probability-based online panel recruited using dual-frame random digit dialling, which does not cover the non-phone population. Excluding non-phone adults, the NHS estimates mobile phone access at

95.3%. The ACMA estimate of mobile usage is 96%. The ACMA also provides estimates of mobile-only status based on Single Source. The NHS estimates the mobile-only share of the population at 40.6%. ACMA estimates mobile usage at 41%. In each case, the ACMA and NHS estimates are within a percentage point of one another. As a result, we have a great deal of confidence that more complex estimates of telephone status, such as by other variables, should be compatible with the existing estimates of telephone access in Australia.

4.3. Changes in telephone status

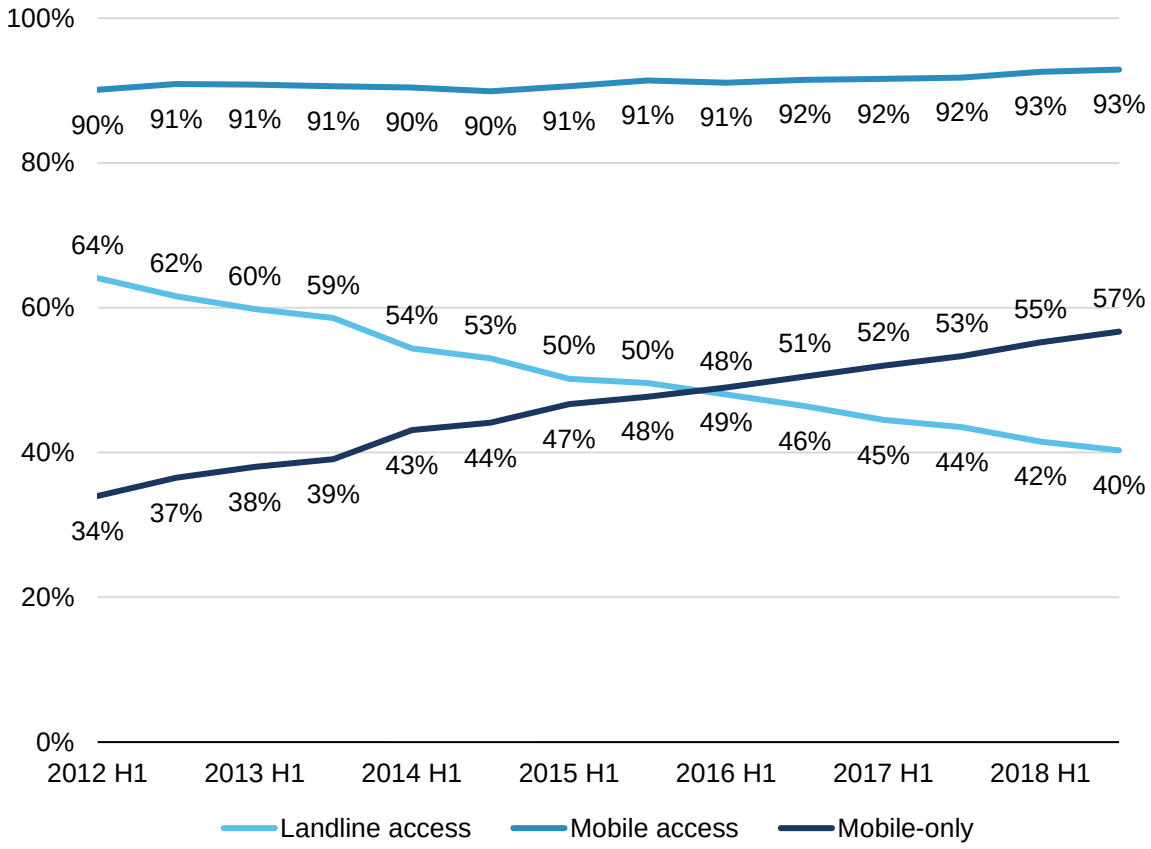
Since 2012, there has been an extended decline in landline access among Australian adults and a concomitant increase in mobile-only status; see Figure 3. As mobile access was already close to universal among Australian adults in 2012, it has increased only gradually since then. By comparison to the U.S. across the same period (Figure 4), it seems likely that landline access in Australia will continue to fall. Both countries exhibit close to linear declines in landline access and linear increases in mobile-only status, with the U.S. being further advanced in the apparent transition to mobile-only.

Figure 3 Adult telephone status by year



Notes: ACMA (2012, 2013, 2014, 2015, 2016, 2017, 2019a). Estimates in this series have been revised by ACMA; we show the most recent estimate available for each year.

Figure 4 U.S. adult telephone status by half-year



Notes: Blumberg & Luke (2007, 2012, 2015, 2019).

4.4. The adequacy of the White Pages frame

White Pages samples ceased to be used in the United States in the late 1970s due to the poor quality of their representation of the population (Massey 1988).[4] The use of White Pages samples, while greatly reduced, has, however, continued into the present day in Australia.[5] The adequacy of the White Pages frame in the Australian environment has been contested, with some authors demonstrating the problematic nature of the frame (Pennay & Challice 2006; Smith et al. 1997; Yang & Eyeson-Annan 2006), while others have argued that biases are small (Dal Grande, Taylor & Wilson 2005; Taylor, Wilson & Wakefield 1998; Teixeira, Zischke & Webley 2016; Wilson et al. 1999). In recent years, however, even former advocates of the White Pages frame have pointed to declining rates of directory listing and rising rates of mobile-only households (Dal Grande & Taylor 2010). Various studies have demonstrated non-ignorable bias from excluding mobile households in Australia (Alexander, Hayes & Durkin 2012; Badcock et al. 2017; Baffour et al. 2017; Holborn, Reavley & Jorm 2012; Jackson et al. 2014; Pennay 2010, 2012).

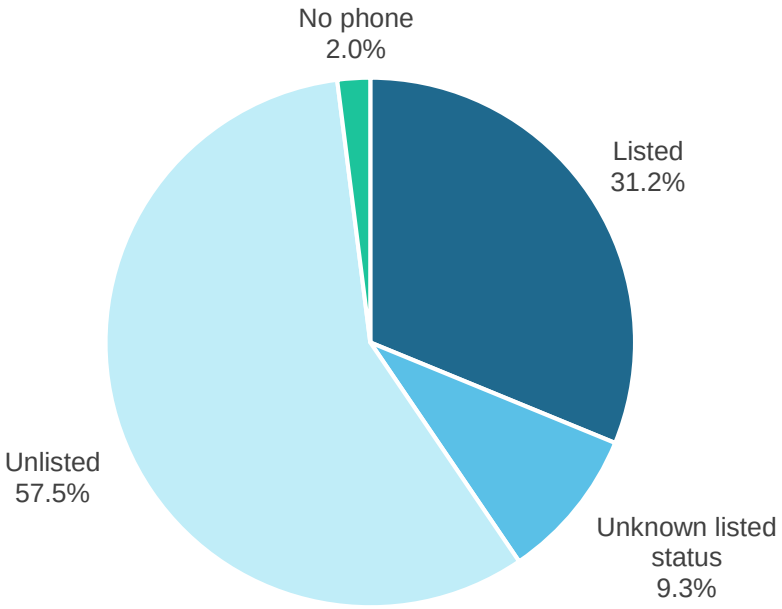
The NHS offers the opportunity to evaluate the quality of directory coverage because the questions asked both landline and mobile users whether their numbers were found on the telephone directory.

[4] The problems with directory samples in the U.S. were realised very early (Cooper 1964; Brunner & Brunner 1971; Fletcher & Thompson 1974; Judd 1966; Leuthold & Scheele 1971; Roslow & Roslow 1972) although there were also arguments in favour of directory samples (Rich 1977).
[5] Examples of contemporary Australian surveys using White Pages samples include the WA Health and Wellbeing Surveillance System (WA Department of Health 2018) and fishing surveys in some states and territories (Lyle, Stark & Tracey 2014; West et al. 2012, 2015).

The majority of the adult population is unlisted (57.6%) or has no phone (2.0%); see Figure 5. A little under a third of adults are listed (31.1%) and slightly fewer than 1 in 10 are unknown (9.3%).[6] As one would expect, the vast majority of mobile phones are unlisted (95.4%). With respect to landlines, 50.6% of adults in landline households reside in a household with a listed landline, 32.7% reside in a household with an unlisted landline and 16.7% reside in a household with an unknown listing status.

Coverage of less than 40% of the population is untenable, particularly for surveys which are used to generate important estimates, such as state-level health data. The untenable nature of White Pages as a sole sampling frame is further reinforced by the fact that the overwhelming majority of mobile numbers are unlisted and that there are—as we document in later sections—non-ignorable differences in many outcomes for mobile-only adults.

Figure 5 Adult listed status



[6] If the observed ratio of listed to unlisted adults is assumed to apply to the unknown fraction of the population, the listed population is estimated to cover 36.7% of adults, the unlisted population to cover 61.2% of adults and those with no phone access to cover 2.0% of adults; totals do not sum to 100% due to rounding error.

5. Geography

There are wide variations in telephone access across Australia, as documented below. This tells us something important about access to telecommunications *per se* and also has important implications for survey research.

5.1. States and territories

There is extensive variation in the rates of not having a telephone and having a landline telephone by state and territory, as seen in Table 1. The Northern Territory has a much higher proportion of adults without telephone service than the rest of the country, with 7.0% of adults in the NT having no telephone compared to less than 3% in other states and the ACT. The NT also relies much less on landlines, with only 32.1% of the adult population living in a household with a landline phone compared to 52.5% to 60.2% in other states and the ACT. Mobile access varies little across the country, however, with a minimum of 90.5% of adults having a mobile phone in the NT and maximum of 94.5% in WA. The effect of state on telephone use persists after other variables are controlled for. These results differ slightly from Baffour et al. (2016), who found the mobile-only population highest in Queensland, Western Australia and the Northern Territory and lowest in Victoria.

Throughout the paper, an asterisk is applied to table cells where the relative standard error (RSE) is greater than or equal to 25%.[7] In all such cases, RSE is below 50%. If RSE in any cell was 50% or greater, cells are collapsed to ensure that RSE is no higher than 25%; if cell collapsing is not viable, no table is shown.

Table 1 Adult telephone status by state/territory

State/ Territory	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
NSW	38.5%	55.2%	4.9%	1.4%	93.7%	60.1%
VIC	37.3%	55.8%	4.4%	2.5%	93.1%	60.2%
QLD	44.9%	47.8%	4.7%	2.7%	92.6%	52.5%
SA	43.9%	49.2%	5.6%	1.3%	93.2%	54.8%
WA	41.8%	52.7%	3.5%	1.9%	94.5%	56.4%
TAS	45.7%	47.9%	5.6%	0.8%*	93.4%	53.5%
NT	60.9%	29.6%	2.6%	7.0%	90.5%	32.1%
ACT	44.9%	48.7%	4.1%	2.3%	93.6%	52.8%

Note: * Relative standard error (RSE) greater than or equal to 25%.

5.2. Capital city and rest of state or territory

Telephone status by capital city and rest of state or territory is shown in Table 2; due to small sample sizes outside of NSW, Victoria and Queensland, we only show capital city/rest of state differences for these states. In Victoria, Melbourne has more dual-users and fewer mobile-only than does the rest of Victoria. In Queensland, mobile access is higher in Brisbane than the rest of the state. The effect of capital/city rest of state persists even after controls are introduced. As can be seen from comparing NSW and Victoria, there does not appear to be a consistent relationship between the capital city and

[7] Relative standard error is standard error (a measure of sampling error) divided by the estimate.

rest of the state. This differs from previous Australian reports, which found higher mobile-only usage in capital cities (Pennay 2010; Jackson et al. 2014; Dowling et al. 2015; Badcock et al. 2017).

Table 2 Adult telephone status in state/territory by capital and rest of state/territory

State/Territory	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Sydney	39.3%	55.5%	4.0%	1.2%	94.8%	59.5%
Rest of NSW	37.0%	54.6%	6.7%	1.7%*	91.6%	61.3%
Melbourne	36.0%	57.0%	4.1%	2.8%	93.1%	61.2%
Rest of VIC	41.5%	51.7%	5.4%	1.4%*	93.2%	57.1%
Brisbane	45.1%	50.2%	3.9%	0.9%*	95.3%	54.1%
Rest of QLD	44.6%	45.4%	5.4%	4.6%	90.0%	50.9%
SA	43.9%	49.2%	5.6%	1.3%	93.2%	54.8%
WA	41.8%	52.7%	3.5%	1.9%	94.5%	56.4%
TAS	45.7%	47.9%	5.6%	0.8%*	93.4%	53.5%
NT	60.9%	29.6%	2.6%	7.0%	90.5%	32.1%
ACT	44.9%	48.7%	4.1%	2.3%	93.6%	52.8%

Notes: ACT has no non-capital areas. * RSE greater than 25%.

5.3. Remoteness

Telephone status by remoteness (ABS 2018b) is shown in Table 3. Mobile access slightly declines as remoteness increases while landline access does not show a clear pattern. Mobile access is highest for Major Cities of Australia and lowest for Outer Regional Australia. Landline access is highest in Inner Regional Australia and lowest in Outer Regional Australia. This is the first publication in Australia, to our knowledge, to examine telephone use by remoteness.

Table 3 Adult telephone status by remoteness

Remoteness	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Major Cities of Aust.	40.5%	53.5%	4.2%	1.8%	94.0%	57.8%
Inner Regional Aust.	38.9%	53.3%	6.2%	1.6%	92.2%	59.5%
Outer Regional Aust.	45.2%	45.2%	4.7%	4.9%	90.4%	49.9%
Remote Aust.	40.6%	50.5%	4.3%*	4.6%*	91.2%	54.8%
Very Remote Aust.	-	-	-	-	-	-

Note: Very Remote Australia was excluded from the NHS 2017-18. * RSE greater than 25%.

5.4. Area-level socio-economic status

There are very strong links between telephone status and the socio-economic status of an area as captured by the Socio-Economic Indexes for Areas (SEIFA; ABS 2016a); see Table 4.[8] Being solely reliant on a mobile phone is least likely in the least disadvantaged areas, with other areas having somewhat higher levels of being mobile-only. By contrast, dual-users are most common in the least disadvantaged areas and least common in the areas of highest socio-economic disadvantage. Having no telephone service is, unsurprisingly, most common in the most disadvantaged areas and least common in the least disadvantaged areas. There are small variations in the availability of mobile phones, with a low of 89.8% in the most disadvantaged segments of the population and a high of 95.8% in the 4th quintile (second least disadvantaged). Landline access is highest in the least disadvantaged areas. We are not aware of other research examining Australian telephone use by SEIFA.

Table 4 Adult telephone status by Socio-Economic Indexes for Areas Quintiles

SEIFA	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
1st – Most disadvantaged	43.2%	46.6%	7.3%	3.0%	89.8%	53.8%
2nd	42.1%	50.4%	5.2%	2.3%	92.5%	55.6%
3rd	43.2%	49.8%	4.7%	2.2%	93.1%	54.6%
4th	40.2%	55.6%	2.8%	1.4%	95.8%	58.4%
5th – Least disadvantaged	34.6%	60.5%	3.6%	1.3%	95.1%	64.1%

Note: National Index of Relative Socio-Economic Disadvantage (IRSD) at the SA1 level is the form of SEIFA shown in this table.

[8] National Index of Relative Socio-Economic Disadvantage (IRSD) at the SA1 level are shown.

6. Demographics

We address the demographic correlates of telephone access in this section, examining age, gender, education, migrant status, language spoken, employment, income and family status.

6.1. Age

Age is strongly related to telephone status, see Table 5. Mobile phone access is strongly related to age. Having a mobile phone is nearly universal up to age 64. The proportion with a mobile phone dips below 90% for those aged 65-74 and reaches 69.9% among those aged 75 and over. Landline access grows with age, except for the youngest adults, who likely have landline service by virtue of living with a parent; a similar phenomenon is observed in Portugal (Vicente & Reis 2009) and the U.S. (Blumberg & Luke 2019). Mobile-only adults form a non-ignorable part of every age cohort except those aged 75 and over. By contrast, the landline-only fraction of the population is small, aside from those aged 75 and over. The relationship between mobile-only status and younger age is widely observed in previous Australian research (Dal Grande & Taylor 2010; Gruszin & Szuster 2010; Pennay 2010; Barr et al. 2012; Livingston et al. 2013; Jackson et al. 2014; Dowling et al. 2015; Baffour et al. 2016, 2017; Badcock et al. 2017) as well as the U.S. (Blumberg & Luke 2007, 2019; Link et al. 2007; Kohut et al. 2008; Peytchev et al. 2010), Brazil (Bernal et al. 2017), Finland (Kuusela et al. 2008) and Lebanon (Sibai et al. 2016). The effect of age on telephone use persists after other variables are controlled for.

Table 5 Adult telephone status by age

Age	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
18-24	48.9%	47.9%	1.3%*	1.9%	96.9%	49.2%
25-34	63.9%	33.3%	0.8%*	2.0%	97.2%	34.1%
35-44	50.6%	46.4%	0.7%	2.3%	97.0%	47.2%
45-54	35.1%	60.5%	2.5%	1.9%	95.6%	63.0%
55-64	29.4%	65.2%	4.0%	1.4%	94.6%	69.2%
65-74	22.0%	66.6%	8.5%	2.9%	88.7%	75.1%
75+	8.8%	61.2%	28.0%	2.0%	69.9%	89.1%

Note: * Relative standard error greater than 25%.

6.2. Gender

There are slight differences in telephone use by gender; see Table 6.[9] However, they cease to be a significant predictor of telephone use when other variables are controlled for. These results are a departure from previous Australian research, which found higher rates of mobile use for males (Pennay 2010; Livingston et al. 2013; Jackson et al. 2014; Dowling et al. 2015; Baffour et al. 2016, 2017; Badcock et al. 2017). This may parallel a trend seen in the U.S., where males were initially more likely to be mobile-only (Blumberg & Luke 2007) but have subsequently ceased to differ from females (Blumberg & Luke 2019) and also in Lebanon, where males were over-represented among mobile users (Sibai et al. 2016).

[9] The differences are statistically significant, although clearly substantively marginal: F = 4.37; DF (numerator) = 2.98; DF (denominator) = 48,598.19; $p \leq .01$.

Table 6 Adult telephone status by gender

Age	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Male	41.9%	51.7%	4.1%	2.2%	93.7%	55.9%
Female	39.3%	53.8%	5.1%	1.9%	93.1%	58.9%

6.3. Education

There are strong relationships between educational attainment and telephone status, as can be seen in Table 7. Mobile-only status is highest for adults with a Bachelor's degree or above and declines progressively among groups with lower levels of educational attainment. Landline-only status is strongly associated with education, with very low levels of being landline-only for adults with Year 12 education and above and much higher levels for adults with less than Year 12 education. Having no phone is twice as common among adults with less than Year 12 education than adults with an Advanced Diploma, Diploma or Certificate III/IV. Having landline access is least common among adults with a Bachelor's degree or above and most common among adults with less than Year 12 education. Mobile access is less common among adults with less than Year 12 education than among adults with Year 12 education and above. These results appear to be, in part, driven by the relationship between education and age and other predictors of telephone use: the effect of education in the models (see section 9) diminishes but is not negated, with the major distinction being between adults with Year 12 education and all other levels of education (higher or lower than Year 12). These findings help to resolve a split in the literature with respect to the relationship between education and mobile use.[10] The results are very different to the U.S. (Link et al. 2007; Tucker et al. 2007; Kohut et al. 2008) and Brazil (Bernal et al. 2017), where mobile-only status is associated with lower levels of education. The only other country known to have a similar pattern of usage to Australia is Lebanon (Sibai et al. 2016).

Table 7 Adult telephone status by education

Education	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Bachelor's degree or above	45.6%	51.4%	1.5%	1.6%	97.0%	52.9%
Adv Dip, Dip or Cert III/IV	42.4%	52.9%	3.2%	1.6%	95.3%	56.0%
Year 12	39.4%	54.8%	3.5%	2.3%	94.3%	58.3%
Less than Year 12	32.4%	52.4%	12.0%	3.3%	84.7%	64.4%

6.4. Indigenous status

Indigenous status is strongly related to telephone status; see Table 8. Indigenous adults are much more likely to be mobile-only than the non-Indigenous population, much less likely to have both mobile and landline service, and are more likely not to have access to a telephone at all. The proportion of the Indigenous population reachable by landline is very low. The effect of Indigenous status persists after other variables are controlled for. These findings mirror those of previous research in Australia, which

[10] No relationship between education and telephone use was found by Pennay (2010) and Baffour et al. (2016). Dal Grande & Taylor (2010), Livingston et al. (2013), Dowling et al. (2015) and Badcock et al. (2017) found higher levels of education among mobile respondents.

found Indigenous Australians over-represented among mobile-only adults (Pennay 2010; Liu et al. 2011; Barr et al. 2012; Jackson et al. 2014).

Table 8 Adult telephone status by indigenous status

Indigenous status	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Indigenous	58.9%	30.5%	5.1%*	5.5%*	89.4%	35.6%
Not Indigenous	40.2%	53.2%	4.6%	2.0%	93.4%	57.8%

Note: * RSE greater than 25%.

6.5. Migrant status

6.5.1. Country of birth

Birthplace (Australian born, overseas born of English-speaking background, overseas born of non-English speaking background) is associated with telephone status, as shown in Table 9, although it is not a significant predictor of telephone status when other migrant status variables are controlled for.[11] People born outside of Australia in English-speaking countries are less likely to be mobile-only and overseas born people from non-English-speaking countries are the most likely to be mobile-only. The proportion with no phone is highest among the overseas born from non-English-speaking countries. Landline availability also varies somewhat by broad birthplace category, being highest for those born in other English-speaking countries and lowest for those born in non-English-speaking countries. The link between migrant status and mobile use found here differs from previous research in Australia, which identified migrant status with higher likelihood of being mobile-only (Pennay 2010; Barr et al. 2012; Jackson et al. 2014; Badcock et al. 2017) but see Dal Grande and Taylor (2010), who found higher mobile use among Australian-born residents of South Australia. In our results, only migrants from non-English speaking countries are more likely to be mobile-only than Australian-born people.

Table 9 Adult telephone status by country of birth

Country of birth	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Australia	40.6%	53.0%	4.5%	1.9%	93.6%	57.5%
Other English-speaking	37.3%	56.9%	4.0%	1.7%	94.3%	61.0%
Non-English-speaking	41.8%	50.3%	5.3%	2.6%	92.2%	55.6%

[11] English-speaking countries were defined as Canada, Ireland, New Zealand, South Africa, the U.K. and Channel Islands and the U.S. This is a classification formerly used by the ABS, which describes it in the following terms: 'The list of main English-speaking countries (MESC) is not an attempt to classify countries on the basis of whether or not English is the predominant or official language of each country. It is a list of the main countries from which Australia receives, or has received, significant numbers of overseas settlers who are likely to speak English. It is important to note that being from a non-main English-speaking country (non-MESC) does not imply a lack of proficiency in English.' (ABS 2013).

6.5.2. Year of arrival

The length of time that overseas-born persons have lived in Australia is also strongly associated with telephone status; see Table 10. More recent arrivals are the most likely to be mobile-only, the least likely to be landline-only and the most likely to have no phone. By contrast, migrants who arrived in Australia prior to 2006 are the least likely to be mobile-only and the most likely to be landline-only. Australian-born adults occupy intermediate positions with respect to mobile-only and landline-only status and are the least likely to have no phone. To a large degree, the differences between adults who migrated before 2006 and Australian born adults disappear when other variables are controlled for. These findings also differ from previous Australian research, which found an effect for migrant status regardless of time from migration.

Table 10 Adult telephone status by year of arrival

Year of arrival	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
2006-18	59.7%	36.5%	1.1%*	2.8%	96.2%	37.5%
Pre-2006	29.2%	61.7%	7.1%	2.0%	90.9%	68.8%
Born in Australia	40.6%	53.0%	4.5%	1.9%	93.6%	57.5%

Note: * RSE greater than 25%.

6.6. Language

6.6.1. English proficiency

Self-rated English proficiency is related to telephone status; see Table 11. The primary source of variation relates to mobile access and access to any telephone; landline access varies only minimally. By contrast, mobile access is at a maximum among those who speak English well or very well but lower among those who do not speak English well or do not speak English at all. Adults with no phone service make up a smaller fraction of those who speak mainly English but a larger fraction of those who do not speak English well or do not speak English at all. The pattern for the landline-only population is similar, being lowest for those who report speaking English well and highest among of those who do not speak English at all or do not speak English well. There is only small variation in the proportion having mobile access only. Having both landline and mobile service is highest amongst those who speak mainly English and who report speaking English well or very well and lowest among those who do not speak English at all or do not speak English well. English proficiency remains a predictor of telephone use after other variables are controlled for. Previous research has not, to our knowledge, addressed the relationship between English proficiency and phone use.

Table 11 Adult telephone status by English proficiency

English proficiency	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Mainly speaks English	40.2%	53.5%	4.5%	1.9%	93.7%	58.0%
Well or very well	44.1%	50.2%	3.3%	2.4%	94.4%	53.5%
Not well or not at all	39.7%	43.5%	11.8%	4.9%*	83.2%	55.5%

Note: * RSE greater than 25%.

6.6.2. English spoken at home

Whether or not English is spoken at home is only modestly correlated with telephone use, as shown in Table 12. Those who speak English at home are slightly more likely to have landline service, slightly more likely to have a mobile phone, slightly less likely to be mobile-only, more likely to be a dual-user, slightly less likely to have only landline service and slightly more likely to have a phone. The impact of language spoken at home reverses when other variables are controlled for (see section 9). As with English proficiency, we are not aware of previous research on the relationship between language spoken at home and telephone use.

Table 12 Adult telephone status by language spoken at home

Language spoken at home	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
English	40.2%	53.5%	4.5%	1.9%	93.7%	58.0%
Non-English	43.1%	48.5%	5.4%	3.0%	91.6%	54.0%

6.7. Employment status

There are large variations in telephone status by employment status, as seen in Table 13. Adults who are not employed (either unemployed or not in the labour force) have higher levels of landline access and lower levels of mobile access than adults who are employed. This is likely to be a product of the fact that older adults are less likely to be in the labour force, more likely to have landline access and less likely to have mobile phones. Similarly, being landline-only is much more common—and being mobile-only is much less common—among adults who are not employed than among adults who are employed. These findings are in line previous national surveys in Australia (Pennay 2010; Jackson et al. 2012). These findings are similar to contemporary data from the U.S. (Blumberg & Luke 2019) and Portugal (Vicente & Reis 2019), where mobile-only status was higher for adults in the labour force, and Lebanon (Sibai et al. 2019), where mobile access was higher for adults in the labour force.

Table 13 Adult telephone status by employment status

Employment status	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Employed	45.8%	51.2%	1.3%	1.7%	97.0%	52.5%
Not employed	30.6%	55.8%	10.9%	2.6%	86.4%	66.8%

7. Health Conditions and Risk Factors

As a health survey, the NHS provides a wealth of information on long-term health conditions and health risk factors. We describe variations in telephone status by body-mass index, fruit and vegetable consumption, hypertension, physical activity, smoking, alcohol use, disability status, psychological distress and self-assessed health. Many of these relationships are a product of the strong relationships between telephone status and other variables, rather than a product of the health conditions or risk factors themselves. Nevertheless, it is important to show the relationship between telephone status and health conditions and risk factors in order to identify potential biases in telephone surveys that inadequately represent the telephone status of the population.

7.1. Body-mass index

There are moderate differences in telephone status by body-mass index, as shown in Table 14. Obese and overweight adults are somewhat more likely to have landline access and less likely to be mobile-only than adults in the normal range. When other variables are controlled for, however, body-mass index ceases to be a significant predictor of telephone status. These findings are in line with prior Australian research that identified mobile-only status as being associated with normal weight; Baffour et al.'s (2017) research in Queensland similarly found that the association between weight and telephone use ceased to be significant when controls were introduced. Earlier U.S. data showed a similar pattern (Blumberg & Luke 2007) but mobile-only status ceased to be related to obesity by 2018 (Blumberg & Luke 2019). Similar to Australian data, lower levels of obesity were found in Lebanon for adults with mobile access (Sibai et al. 2016).

Table 14 Adult telephone status by body-mass index

Body weight	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Normal range	45.0%	49.1%	4.0%	1.9%	94.1%	53.1%
Overweight	40.3%	53.3%	4.5%	1.9%	93.7%	57.9%
Obese	36.2%	56.0%	5.4%	2.3%	92.3%	61.4%

Note: Underweight excluded due to small sample size.

7.2. Fruit and vegetable consumption

7.2.1. Vegetable consumption

There are only small variations in telephone status by vegetable consumption; see Table 15. Landline access is somewhat higher among adults who consume more vegetables. Being reachable only by mobile is more common among those who consume fewer vegetables. Vegetable consumption, however, ceases to be a significant predictor of telephone status when other variables are controlled for. We are not aware of prior research on the relationship between vegetable consumption and telephone use, either in Australia or overseas.

Table 15 Adult telephone status by usual daily serves of vegetables

Daily serves of vegetables	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
< 1 serve/day	44.3%	47.2%	6.2%	2.3%	91.5%	53.4%
1-2 serves/day	41.7%	52.2%	4.4%	1.7%	93.9%	56.6%
3-4 serves/day	38.7%	54.2%	4.9%	2.2%	93.0%	59.1%
5+ serves/day	38.3%	54.6%	4.1%	3.0%	93.0%	58.7%

7.2.2. Fruit consumption

Similar patterns to vegetable consumption apply to fruit consumption, as shown in Table 16. Adults who consume more fruit are more likely to have landline access and less likely to be reachable only by a mobile phone. Like vegetable consumption, fruit consumption also ceases to be a significant predictor of telephone status when other variables are controlled for. As is the case for vegetable consumption, we have not found prior research on the relationship between fruit consumption and telephone use.

Table 16 Adult telephone status by usual daily serves of fruit

Daily serves of fruit	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
< 2 serves/day	43.5%	50.0%	4.3%	2.2%	93.5%	54.3%
2+ serves/day	37.8%	55.4%	5.0%	1.8%	93.2%	60.4%

7.3. Hypertension

There is a strong relationship between telephone status and hypertension; see Table 17. Adults with hypertension are less likely to have a mobile phone and more likely to have landline access than adults who do not have hypertension. Mobile-only status is much more common among adults who do not have hypertension. Landline-only status is more common among adults with hypertension. Hypertension is not a significant predictor of telephone status when other variables are controlled for. These findings are similar to those for Lebanon, where hypertension was lower among adults with mobile access (Sibai et al. 2016).

Table 17 Adult telephone status by hypertension

Has hypertension	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Yes	29.4%	59.5%	8.7%	2.4%	88.9%	68.2%
No	46.3%	49.3%	2.6%	1.9%	95.6%	51.9%

7.4. Physical activity

Telephone status varies little by physical activity as measured by the 2014 Physical Activity and Sedentary Behaviour Guidelines (Australian Government Department of Health 2019); see Table 18.[12] These findings are in line with earlier Australian research (Baffour et al. 2016, 2017) and similar to U.S. research (Blumberg & Luke 2019). Physical activity is not a significant predictor of telephone status when other variables are controlled for.

Table 18 Adult telephone status by meeting 2014 physical activity guidelines

Met 2014 guidelines	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Yes	43.0%	52.7%	3.1%	1.2%	95.7%	55.8%
No	40.1%	52.8%	4.9%	2.2%	92.9%	57.7%

7.5. Smoking

There are large variations in telephone status by smoking status, as shown in Table 19. Ex-smokers and adults who had never smoked were much more likely to have landline access than current smokers. Current smokers were, conversely, more likely to be mobile-only. The relationship between smoking and mobile-only status is well established in prior Australian research (Dal Grande & Taylor 2010; Gruszin & Szuster 2010; Pennay 2010; Livingston et al. 2013; Dowling et al. 2015; Baffour et al. 2016, 2017) as well as U.S. research (Blumberg & Luke 2007, 2019). Smoking remains a significant predictor of telephone status when other variables are controlled for, in keeping with findings from Baffour et al. (2017).

Table 19 Adult telephone status by smoking status

Smoking status	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Current smoker	50.6%	43.1%	3.6%	2.8%	93.6%	46.8%
Ex-smoker	36.7%	56.1%	5.3%	1.8%	92.9%	61.4%
Never smoked	39.9%	53.6%	4.5%	1.9%	93.5%	58.2%

7.6. Alcohol use

The risks of alcohol use are divided into lifetime risks from excessive usage, such as cirrhosis, and short-term risk of injury from excessive alcohol consumption. Lifetime risks are classified as consuming in excess of two standard drinks on any day; short-term risks are classified as consuming in excess of four standard drinks on any day (NHMRC 2009).

[12] Although the differences are small, they are statistically significant: F = 7.73; DF (numerator) = 2.92; DF (denominator) = 47,536.13; $p \leq .001$.

7.6.1. Lifetime risk

There was a modest relationship between telephone status and lifetime risk from alcohol consumption; see Table 20.[13] Those adults who exceeded lifetime risk guidelines had the lowest levels of landline access, while those who never consumed alcohol had the highest levels of landline access. Mobile-only status was highest among adults who had exceeded the guideline and lowest among adults who had never consumed alcohol. Landline-only status was far more common for adults who had never consumed alcohol than any other group. Lifetime risk from alcohol consumption persisted when other factors were controlled for. Previous research in Australia and the U.S. has focused on short-term risk from alcohol consumption.

Table 20 Adult telephone status by lifetime risk from alcohol consumption

Lifetime risk	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Exceeded guidelines	46.2%	49.3%	2.4%	2.1%	95.5%	51.8%
Did not exceed guidelines	39.7%	55.7%	2.9%	1.8%	95.3%	58.6%
Last consumed alcohol 1 week or more ago	40.2%	52.1%	5.6%	2.1%	92.2%	57.7%
Never consumed alcohol	37.3%	50.1%	10.0%	2.6%	87.5%	60.1%

7.6.2. Short-term risk

Similar to lifetime risk, exceeding short-term risk guidelines is also associated with lower levels of landline access and greater likelihood of being mobile-only, as shown in Table 21.[14] Adults who never consumed alcohol or who had last consumed alcohol 12 months or more ago were much more likely to be reachable by landline-only. Short-term risk from alcohol remains a predictor of telephone use even when other variables are controlled for. Other research in Australia (Pennay 2010; Livingston et al. 2013; Jackson et al. 2014; Dowling et al. 2015; Baffour et al. 2017), the U.S. (Link et al. 2007; Blumberg & Luke 2007, 2019) and Lebanon (Sibai et al. 2016) similarly found a link between binge drinking and mobile-only status. Similar to our findings, Baffour et al. (2017) determined that the relationship between high risk drinking and mobile-only status persisted when age was controlled for. By contrast, Livingston et al. (2013) did not find that the relationship persisted after controls for age, sex, location and education.

[13] 7-day average and NHMRC (2009) guidelines.
[14] 7-day average and NHMRC (2009) guidelines.

Table 21 Adult telephone status by short-term risk from alcohol consumption

Short-term risk	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Exceeded guidelines	48.8%	47.9%	1.4%	1.9%	96.7%	49.3%
Did not exceed guidelines	33.2%	59.9%	5.1%	1.8%	93.1%	64.9%
Last consumed alcohol 12 months or more ago	36.4%	50.4%	10.3%	2.9%	86.8%	60.7%
Never consumed alcohol	37.3%	50.1%	10.0%	2.6%	87.5%	60.1%

7.7. Disability status

There are strong links between disability status and telephone status; see Table 22. Broadly speaking, landline access increases and mobile access decreases as the activity limitations imposed by the disability become more severe. Landline-only status is most common among adults with profound or severe core activity limitations, followed by those with mild and then moderate limitations. Adults without a disability or long-term health condition, without limitations or specific restrictions, or with schooling or employment restrictions only are much less likely to be landline-only. The picture is reversed with respect to mobile-only status, with mobile-only status being most common among adults without a disability or long-term health condition, or a disability with minimal restrictions, and less common among adults with activity limitations. The effect of disability status on telephone use persists when other variables were controlled for. Disability status in Lebanon, the only other country for which we have been able to identify data, was associated with decreased likelihood of mobile use (Sibai et al. 2016).

Table 22 Adult telephone status by disability status

Disability status	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Profound/severe core activity limitation	27.8%	47.1%	21.3%	3.8%	74.9%	68.3%
Moderate core activity limitation	33.0%	57.4%	7.2%	2.4%	90.5%	64.6%
Mild core activity limitation	26.6%	59.0%	12.4%	2.0%	85.6%	71.4%
Schooling/employment restriction only	42.9%	49.3%	4.4%	3.4%*	92.3%	53.7%
No limitation or specific restriction	40.4%	54.5%	3.4%	1.7%	94.9%	58.0%
No disability or long-term health condition	44.0%	51.7%	2.4%	1.8%	95.7%	54.2%

Note: * RSE greater than 25%.

7.8. Psychological distress

The assessment of psychological distress is assessed based on the 10-item Kessler index (ABS 2012). Psychological distress correlates only modestly with telephone status, as seen in Table 23. Adults with lower levels of distress have higher levels of landline access. However, landline-only and mobile-only status is most common among adults with higher levels of psychological distress. Psychological distress ceases to be a significant predictor of telephone status when other variables are controlled for. Previous research in Australia has mostly identified mobile-only status with higher levels of psychological distress (Jackson et al. 2014; Dowling et al. 2015; Baffour et al. 2016); but see Pennay (2010). Recent U.S. research also found a connection between mobile-only status and higher rates of psychological distress (Blumberg & Luke 2019).

Table 23 Adult telephone status by psychological distress

Psychological distress level	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Low	39.1%	54.9%	4.2%	1.8%	94.0%	59.1%
Moderate	42.6%	52.1%	3.6%	1.8%	94.7%	55.6%
High	45.2%	46.6%	6.2%	2.0%	91.8%	52.8%
Very high	44.4%	45.1%	8.1%	2.3%*	89.7%	53.3%

Note: * RSE greater than 25%.

7.9. Self-assessed health

A relatively strong relationship exists between self-assed health and telephone status, most likely a result of the decline in health with advancing age; see Table 24. As self-assessed health worsens, landline access increases and mobile access declines. Adults with fair or poor self-assessed health are much more likely to be landline-only and less likely to be mobile-only, although self-assessed health ceases to be a significant predictor of telephone status when other variables are controlled for. These data help to resolve what had been a difference in findings in prior Australian research, with Dowling et al. (2015) finding a difference and Pennay (2010) not finding one. U.S. (Blumberg & Luke 2007, 2019) research also identified a connection between mobile-only status and reporting excellent or very good health. Similarly, adults with mobile access in Lebanon were more likely to be in very good or better health (Sibai et al. 2016).

Table 24 Adult telephone status by self-assessed health

Self-assessed health	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Excellent	44.0%	52.1%	2.2%	1.7%	96.1%	54.4%
Very good	41.4%	53.9%	2.9%	1.8%	95.3%	56.8%
Good	41.0%	52.5%	4.4%	2.1%	93.5%	56.9%
Fair	35.1%	51.3%	10.8%	2.8%	86.4%	62.1%
Poor	28.5%	52.1%	16.6%	2.8%	80.6%	68.8%

8. Household Characteristics

To this point, we have presented the characteristics of adults. In this section, we show the relationship between telephone status and household characteristics: family composition, tenure type and household income.

8.1. Family composition

Family composition correlates strongly with household telephone status, as shown in Table 25. Family households with children and one-person households are the most likely to be mobile-only, while couple only family households are the least likely to be mobile-only. Having only a landline phone is most common in one-person households and least common in family households with children. There are only small variations in having no telephone by family composition of household. Family composition remains a predictor of telephone status even after other variables are controlled for. These findings are a distinct shift from previous Australian research, which identified mobile-only status as being associated with group households (Pennay 2010; Jackson et al. 2014; Dowling et al. 2015; Badcock et al. 2017). Our findings regarding Australia differ from recent U.S. research that found mobile-only status was associated with living with unrelated adult roommates (Blumberg & Luke 2019).

Table 25 Household telephone status by family composition

Family composition	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Family household with children	44.9%	53.7%	0.2%*	1.2%	98.6%	54.0%
Couple only family household	34.5%	60.8%	3.1%	1.6%	95.3%	63.8%
One-person household	43.1%	43.6%	10.8%	2.5%	86.6%	54.5%
Other household	37.2%	60.3%	1.3%	1.3%	97.5%	61.2%

Note: * RSE greater than 25%.

8.2. Household tenure

Household tenure is strongly related to telephone status; see Table 26. Renters are much more likely to be mobile-only, while owners without mortgages are the least likely to have a mobile at all. Landline-only status is highest among owners without mortgages and lowest among owners with mortgages. Household tenure is not, however, a significant predictor of telephone status when other variables are controlled for. These findings are in keeping with prior Australian research (Pennay 2010; Jackson et al. 2014; Dowling et al. 2015; Baffour et al. 2016). The high prevalence of renters among the mobile-only in Australia is also observed in the U.S. (Tucker et al. 2007; Blumberg & Luke 2019) and Finland (Kuusela et al. 2008), though not Lebanon (Sibai et al. 2016).

Table 26 Household telephone status by tenure type

Tenure type	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
Owner without a mortgage	20.3%	70.5%	7.8%	1.4%	90.8%	78.3%
Owner with a mortgage	40.1%	57.8%	0.7%	1.4%	97.9%	58.5%
Renter	64.1%	30.7%	2.8%	2.4%	94.8%	33.6%

Note: Excludes other types of households due to small sample size.

8.3. Household income

Household income correlates strongly with telephone status; see Table 27. Landline-only telephony status and not having a telephone at all is highest among low income households while being mobile-only is highest among the wealthiest households. We show equivalised household income, which is 'total household income adjusted by the application of an equivalence scale to facilitate comparison of income levels between households of differing size and composition' (ABS 2016b).[15] Income remains associated with telephone status after other variables are controlled for. With respect to prior Australian research, our findings are closest to Dowling et al. (2015), who found higher representation of adults with mobile access among those earning $60,000 to $100,000 than those earning below $60,000. The difference from earlier findings (Dal Grande & Taylor 2010; Barr et al. 2012) may be due to shifts in the profile of mobile users. The relationship between income and telephone use differs considerably in Australia from the U.S. and Finland, where household income is lower among the mobile-only population (Kohut et al. 2008; Kuusela et al. 2008) and poverty is higher among the mobile-only population (Blumberg & Luke 2007, 2019).

Table 27 Household telephone status by household income

Household income	Mobile-only	Dual-user	Landline-only	No phone	Any mobile	Any landline
First Quintile – Lowest	36.9%	50.0%	10.6%	2.5%	87.0%	60.6%
Second Quintile	37.2%	54.4%	6.7%	1.8%	91.5%	61.0%
Third Quintile	38.6%	58.8%	1.4%	1.2%	97.4%	60.1%
Fourth Quintile	43.7%	54.5%	0.8%	1.0%	98.2%	55.3%
Fifth Quintile – Highest	46.8%	51.9%	0.5%*	0.8%	98.7%	52.4%

Note: * RSE greater than 25%.

[15] Equivalised household income accounts for the fact that 'larger households usually require a greater level of income to maintain the same material standard of living as smaller households' and that 'the needs of adults are usually greater than the needs of children' (ABS 2019b). An equivalising factor of 0.5 is used for each additional adult after the first and a factor of 0.3 is used for each child.

9. Modelling Telephone Status

Many of the factors associated with telephone status discussed in the preceding sections are correlated. People with higher levels of education, for example, tend to have higher levels of income. In order to understand which factors truly drive telephone status, we model telephone status as a function of these variables in order to identify the unique impact of each characteristic. We model overall telephone status in section 9.1, mobile phone status in section 9.2 and landline status in section 9.3.

The same approach to model building is used in each case:

- Model 1 consists of demographics only. Age, gender, education, Indigenous status and the interaction of age and education are tested. Only the final model is shown, excluding variables that were not significant, except for gender, which is retained as a control regardless of its significance.
- Model 2 adds variables associated with immigration to the final form of Model 1. Language spoken at home, English proficiency and year of arrival are tested. Country of birth is excluded due to multicollinearity. Only the final model is shown, excluding variables that were not significant.
- Model 3 adds household type to the final form of Model 1. Only the final model is shown, excluding variables that were not significant.
- Model 4 adds economic variables to the final form of Model 1. Labour force status and household income are tested. Only the final model is shown, excluding variables that were not significant.
- Model 5 adds geographic variables to the final form of Model 1. State, capital city/rest of state, remoteness, SEIFA and the interaction of state and capital city/rest of state are tested. Where the interaction between state and capital city/rest of state was significant, the version of state and capital city/rest of state shown in Table 2 is used. Only the final model is shown, excluding variables that were not significant.
- Model 6 is the final model, constructed out of the significant predictors from Models 1 to 5. Only the final model is shown, excluding variables that were not significant.
- Model 7 then adds health-related variables to the final form of Model 6. Smoking, alcohol risks, disability, emotional distress and self-assessed health are included. Only the final model is shown, excluding variables that were not significant.

9.1. Telephone status

Telephone status is predicted by age, gender (though it is no longer significant after health-related variables are controlled for in Model 7), education, Indigenous status, whether English is spoken at home, English proficiency, year of arrival in Australia, household type, labour force status, household income, state/territory, capital city/rest of state, remoteness, SEIFA, smoking status, alcohol risk and disability status (Table 28). To illustrate these variables, we show estimates from the final model.[16] The results are summarised below:

[16] The models hold all variables other than that shown at their means unless otherwise noted.

- Age is very strongly associated with telephone status after holding other factors constant, with the mobile-only proportion being highest among 25-34-year-olds and declining thereafter (Figure 6). The dual-user fraction increases as the mobile-only fraction diminishes. A negligible proportion of all age groups except those aged 75 and above are landline-only.
- Adults with Year 12 education are outliers after holding all other factors constant, in that they are less likely to be mobile-only and more likely to be dual-users than those with either lower or higher levels of education (Figure 7).
- Indigenous status is associated with a much higher likelihood of being mobile-only and decreased likelihood of being a dual-user, holding other factors constant (Figure 8).
- Controlling for other factors, speaking a language other than English at home is associated with *decreased* likelihood of being mobile-only and *increased* likelihood of being a dual-user (Figure 9); the direction of these effects is opposite to that shown by a simple tabulation.
- Higher levels of fluency in English are strongly associated with greater likelihood of being a dual-user and decreased likelihood of being mobile-only, holding other factors constant (Figure 10).
- Recency of migration is associated with higher likelihood of being mobile-only and lower likelihood of being a dual-user, controlling for other factors (Figure 11). The most recent migrants are particularly likely to be mobile-only, while those who migrated prior to 2006 are indistinguishable from those born in Australia.
- One-person households are more likely to be mobile-only, holding other factors constant. Family with children households are the most likely to be dual-users, and couple-only families occupy an intermediate position (Figure 12).
- Differences by labour force status are very small, controlling for other factors (Figure 13).
- There are small differences in telephone status by household income, holding other factors constant. Adults in households in the lower 40% of the income distribution are the most likely to be mobile-only and the least likely to be dual-users (Figure 14).
- Controlling for other factors, adults in the Northern Territory are by far the most likely to be mobile-only and the least likely to be dual-users (Figure 15). By contrast, adults from NSW, Victoria and Western Australia are the least likely to be mobile-only and the most likely to be dual-users.
- Adults who did not live in a state/territory capital are somewhat more likely to be mobile-only and less likely to be dual-users, holding other factors constant (Figure 16).
- Holding other factors constant, adults in remote areas are less likely than those from less remote areas to be mobile-only and more likely to be dual-users (Figure 17). Very remote areas were not included in the NHS 2017-18.
- There are only modest differences in telephone status by area-level socio-economic status, controlling for other factors (Figure 18).
- Smokers were more likely to be mobile-only and less likely to be dual-users than either ex-smokers or non-smokers, holding all other factors constant (Figure 19).
- There is a quite strong association between lifetime risk of harm from alcohol and telephone status, holding other factors constant. Adults who exceeded guidelines are the most likely to be mobile-only and the least likely to be dual-users, followed by those who had consumed

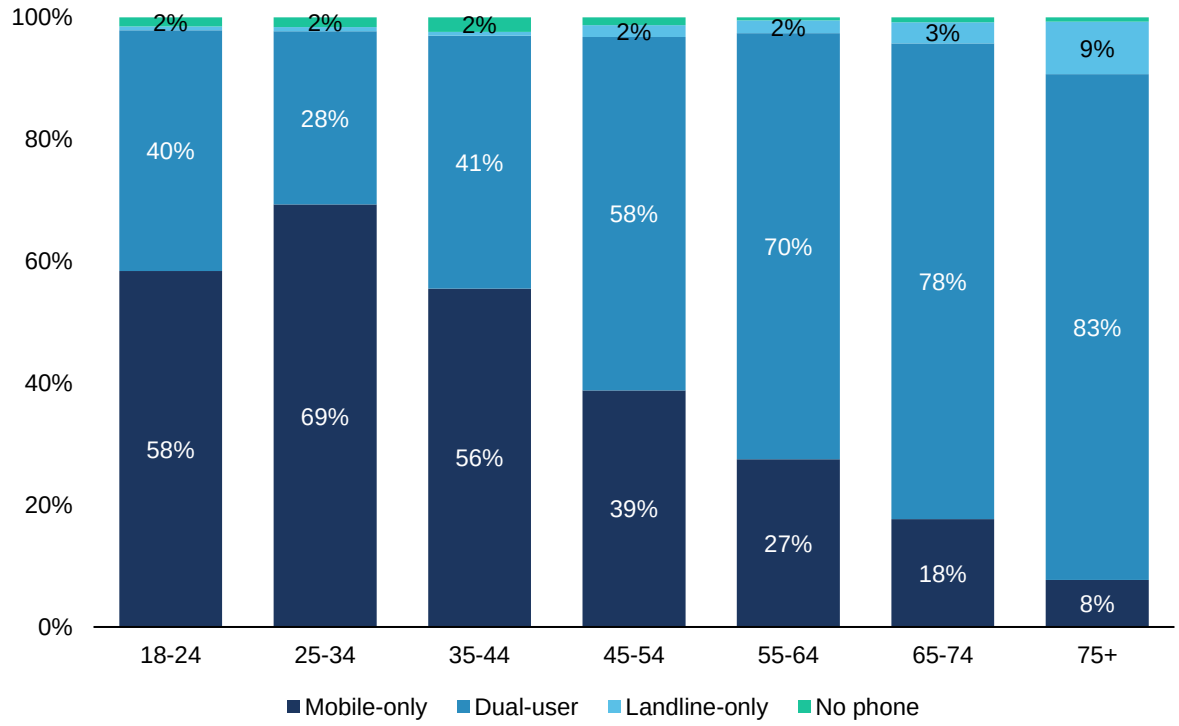
alcohol in the past week but hadn't exceeded the guidelines, then those who had not consumed alcohol in the past week or who had never consumed alcohol, who are the least likely to be mobile-only and the most likely to be dual-users (Figure 20).[17]

- Holding other factors constant, short-term risk of harm from alcohol consumption is associated with telephone status (Figure 21). Adults who had exceeded guidelines are the most likely to be mobile-only and the least likely to be dual-users.
- There are weak relationships between disability and telephone use, controlling for other factors (Figure 22).

Predicted probability

The figures show the predicted probability of different types of telephone service derived from the regression model, holding all other factors at their means (unless otherwise noted). This is not equivalent to the distribution of these values in the population.

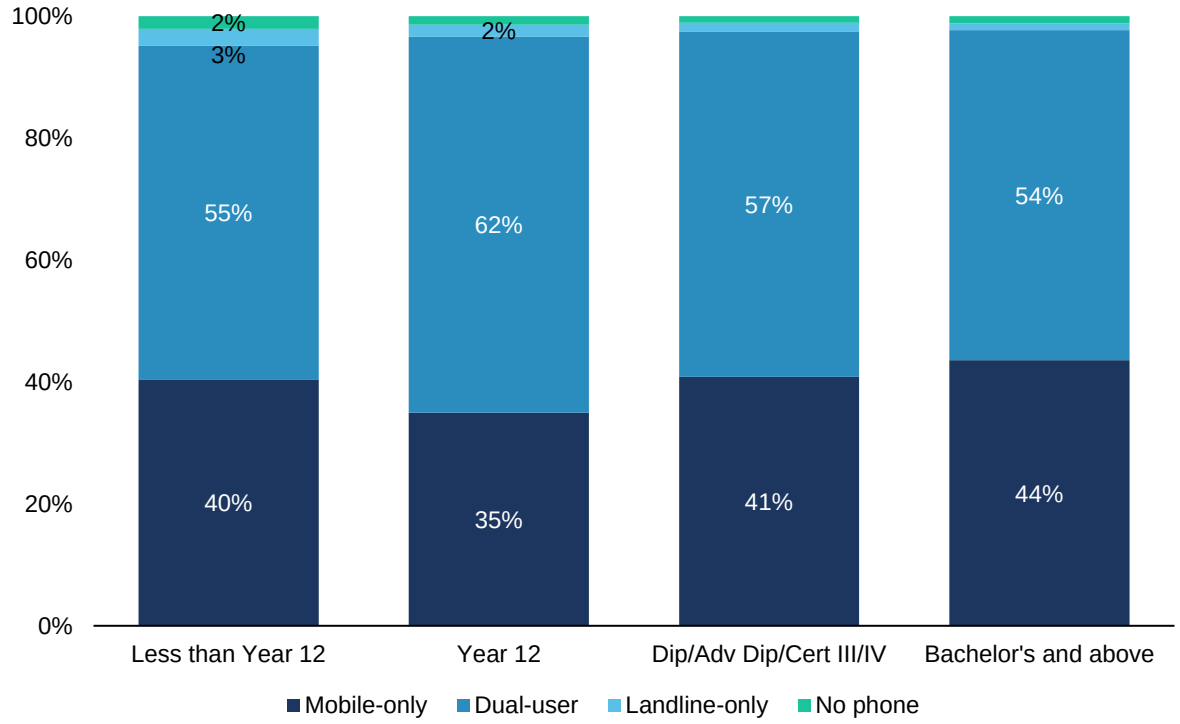
Figure 6 Predicted probability of telephone status by age group



Note: Value labels for 1% and below are suppressed.

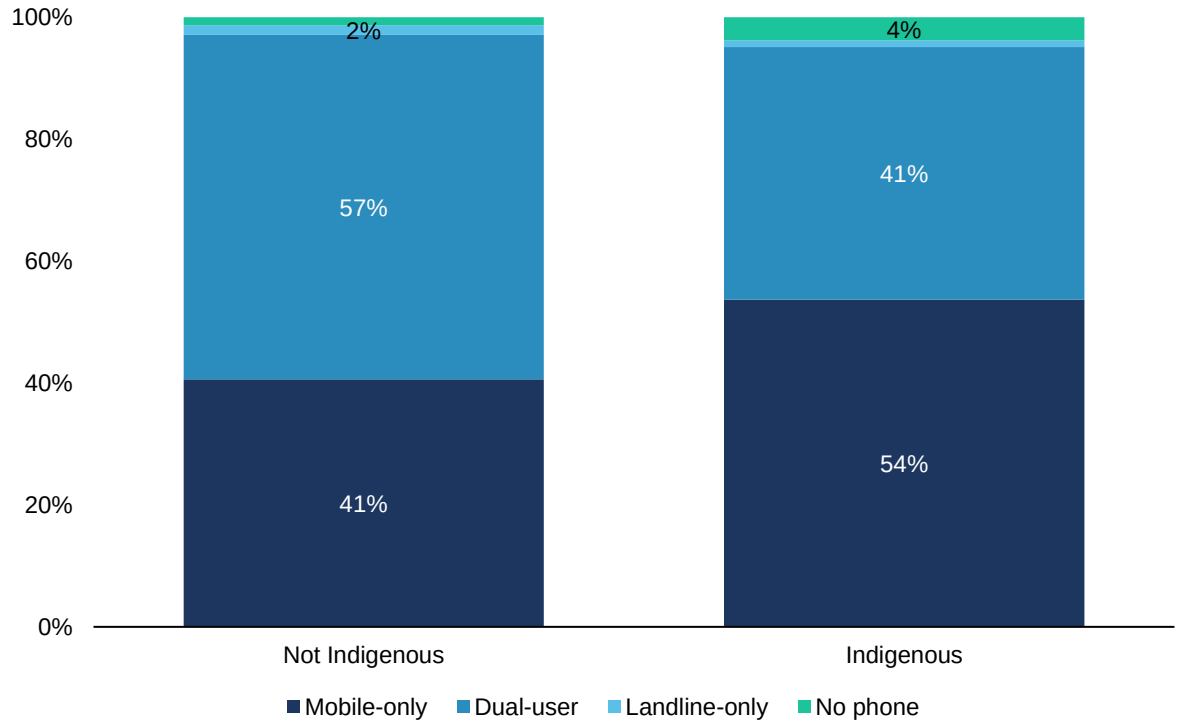
[17] Because lifetime and short-term risk are closely correlated, we take account of this relationship in our estimates. See notes to Figure 20 and Figure 21 for further details.

Figure 7 Predicted probability of telephone status by education



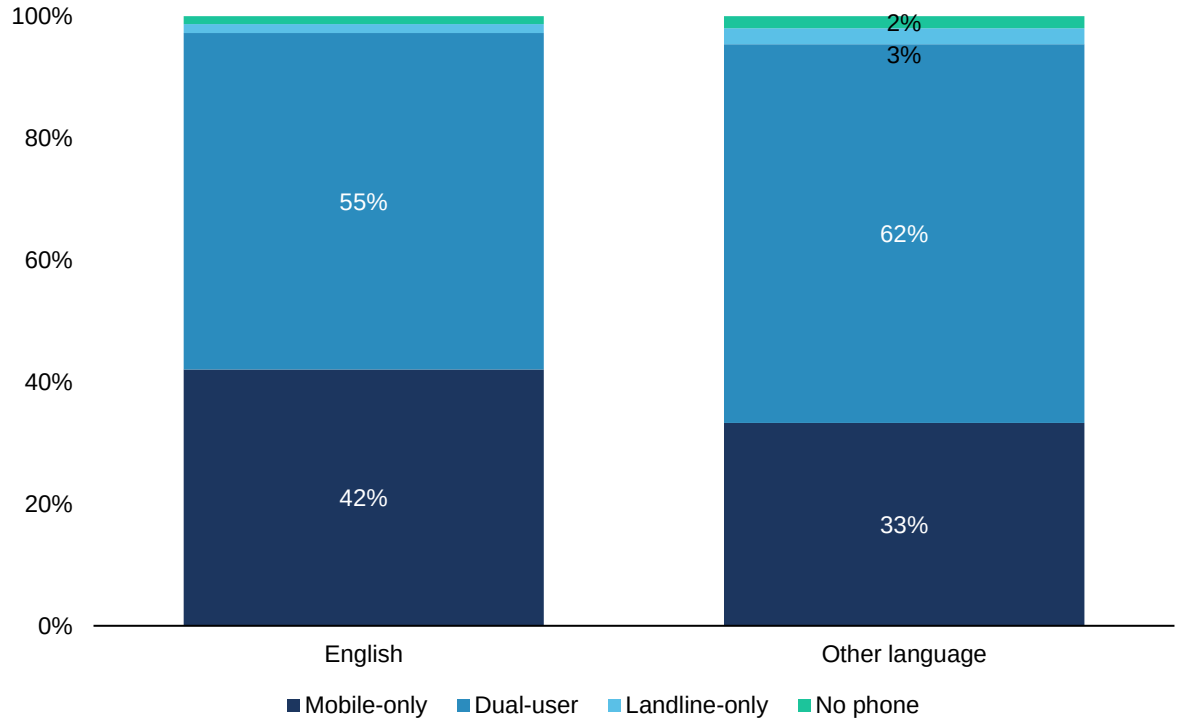
Note: Value labels for 1% and below are suppressed.

Figure 8 Predicted probability of telephone status by Indigenous status



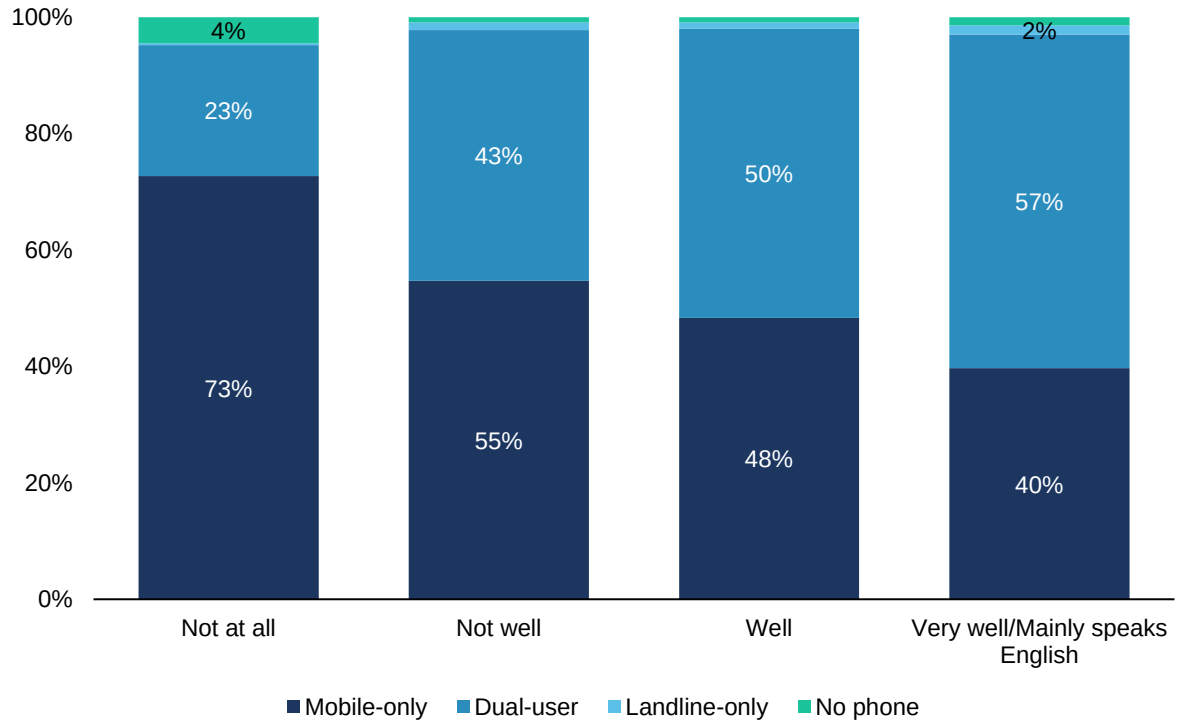
Note: Value labels for 1% and below are suppressed.

Figure 9 **Predicted probability of telephone status by language spoken at home**



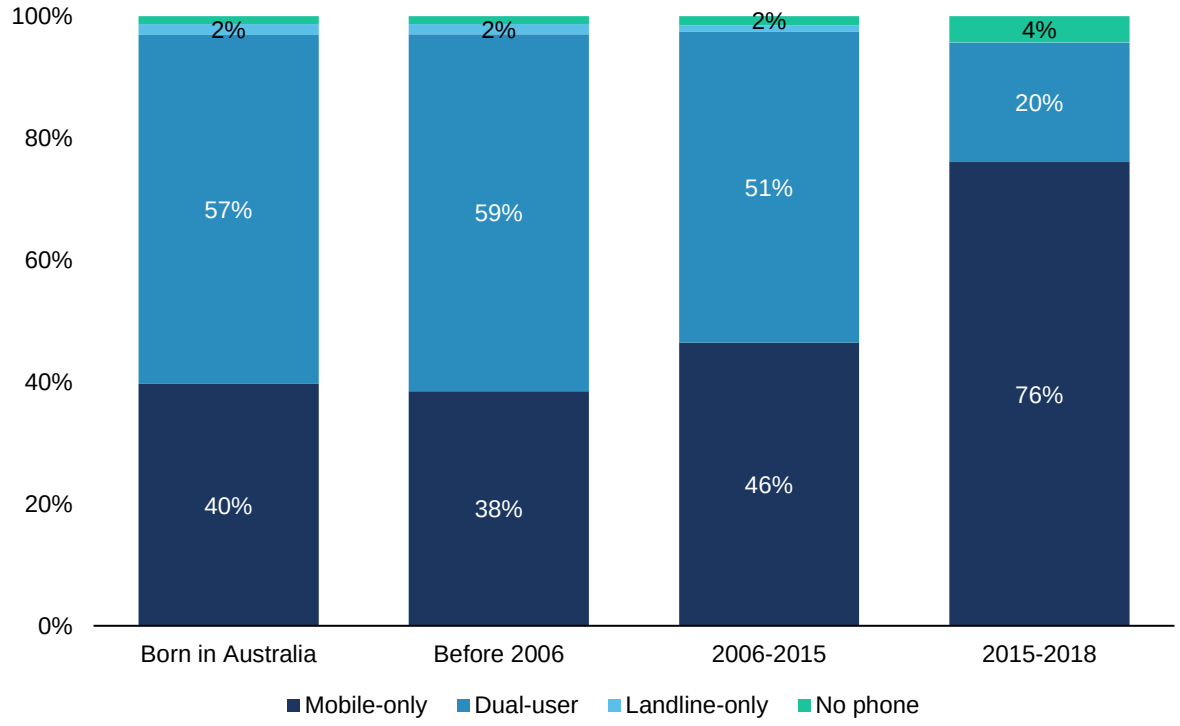
Note: Value labels for 1% and below are suppressed.

Figure 10 **Predicted probability of telephone status by spoken English proficiency**



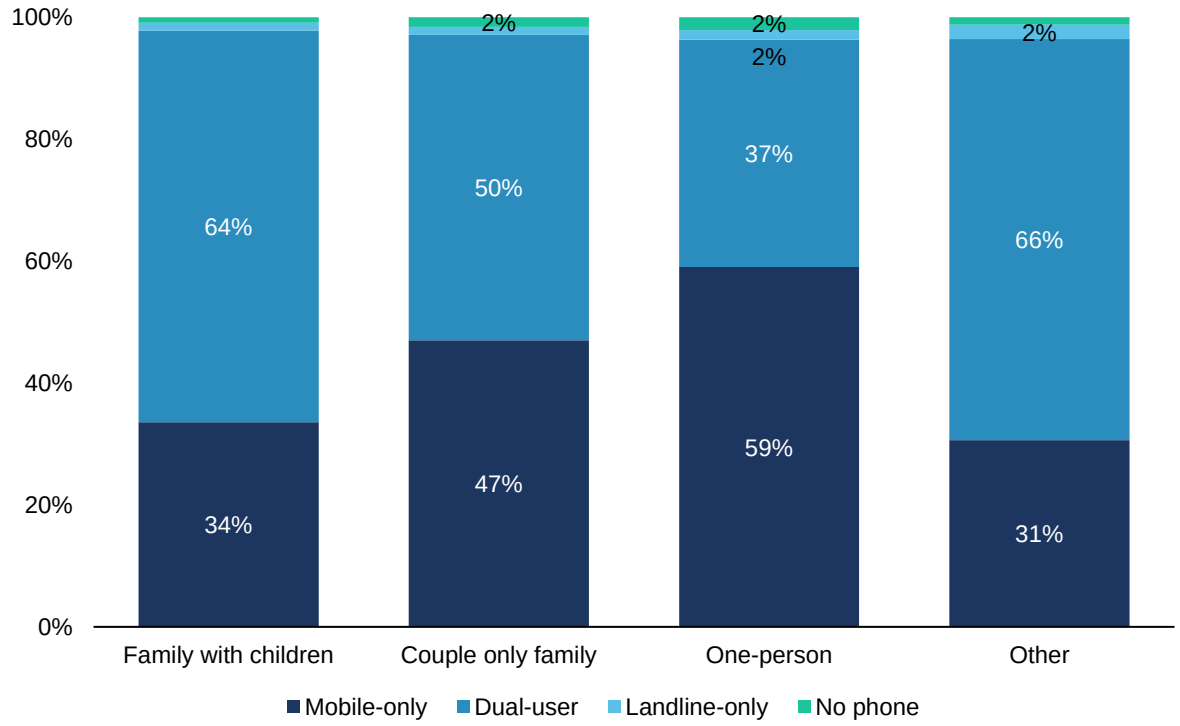
Note: Value labels for 1% and below are suppressed.

Figure 11 Predicted probability of telephone status by year of arrival in Australia



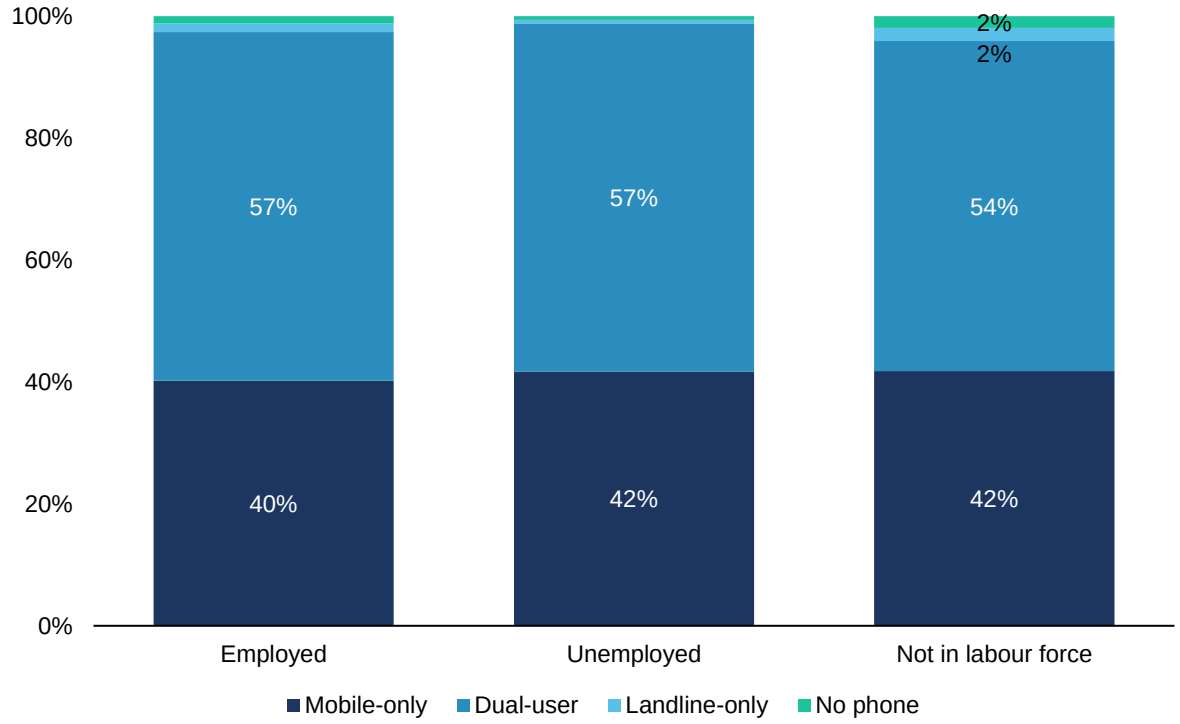
Note: Value labels for 1% and below are suppressed.

Figure 12 Predicted probability of telephone status by household type



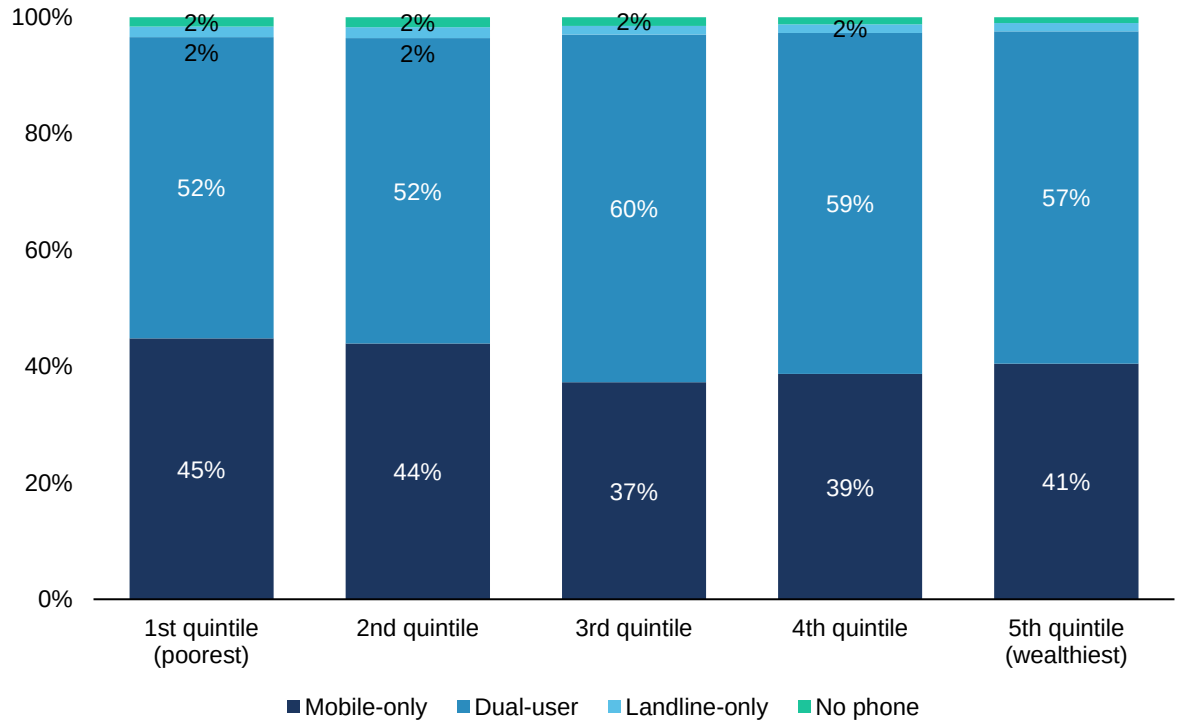
Note: Value labels for 1% and below are suppressed.

Figure 13 Predicted probability of telephone status by labour force status



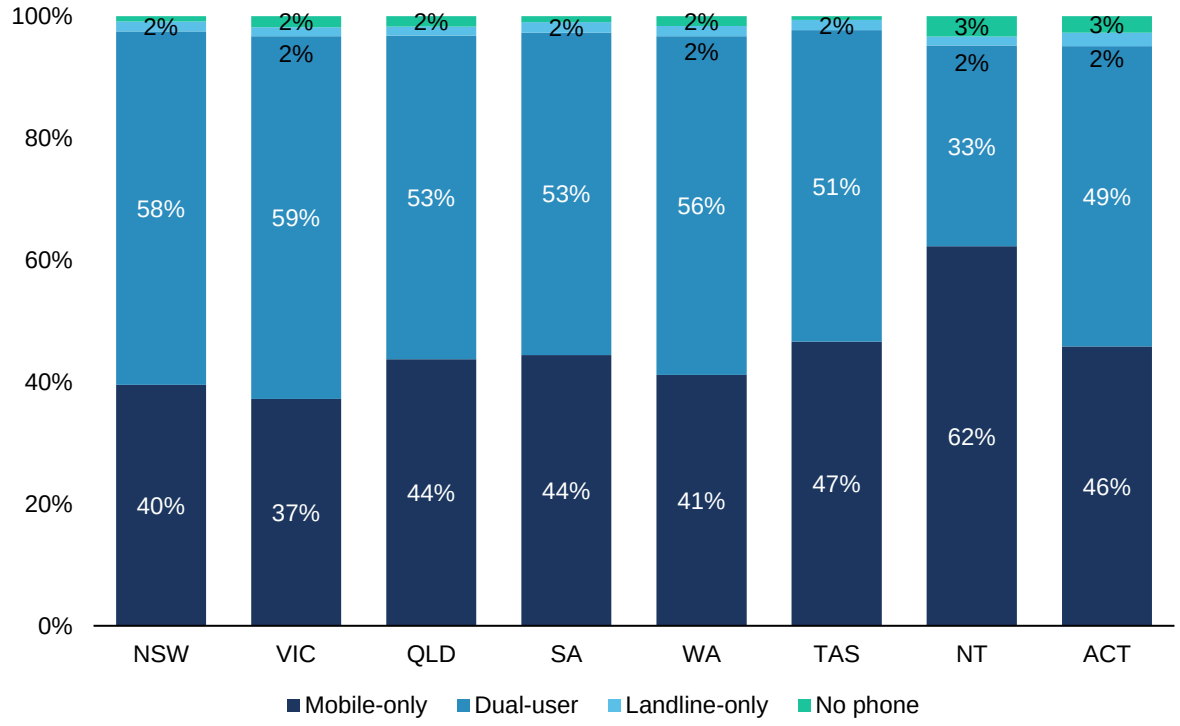
Note: Value labels for 1% and below are suppressed.

Figure 14 Predicted probability of telephone status by equivalised household income



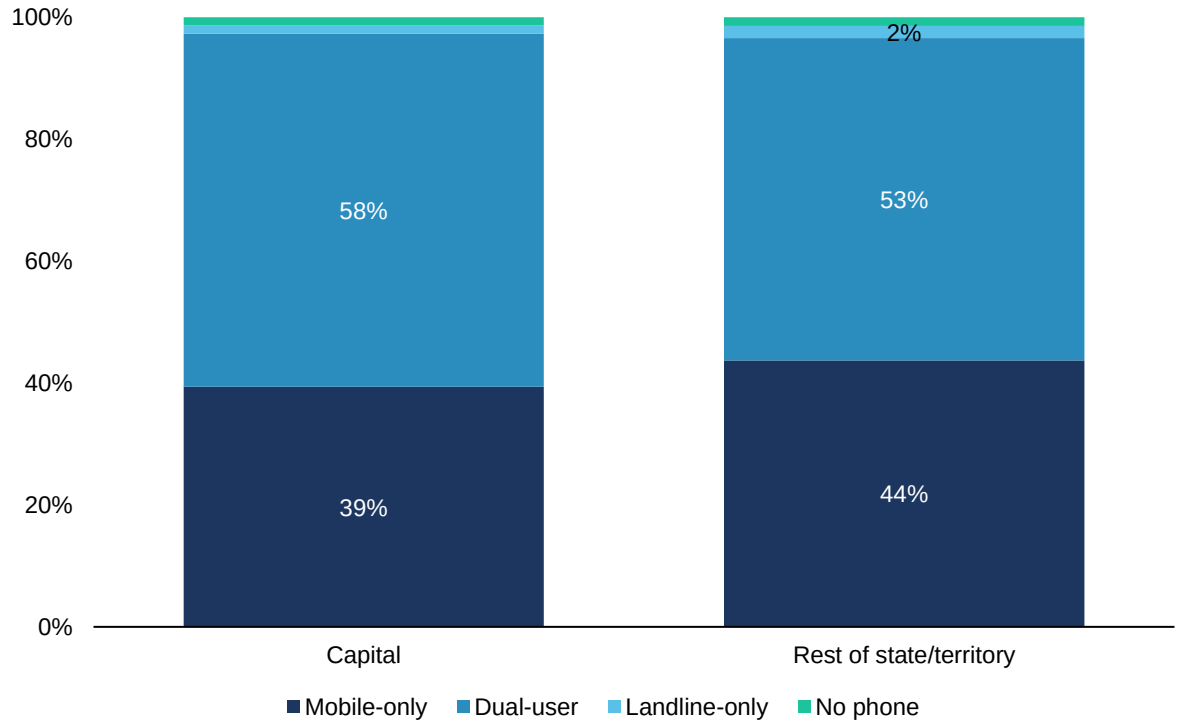
Note: Value labels for 1% and below are suppressed.

Figure 15 Predicted probability of telephone status by state/territory



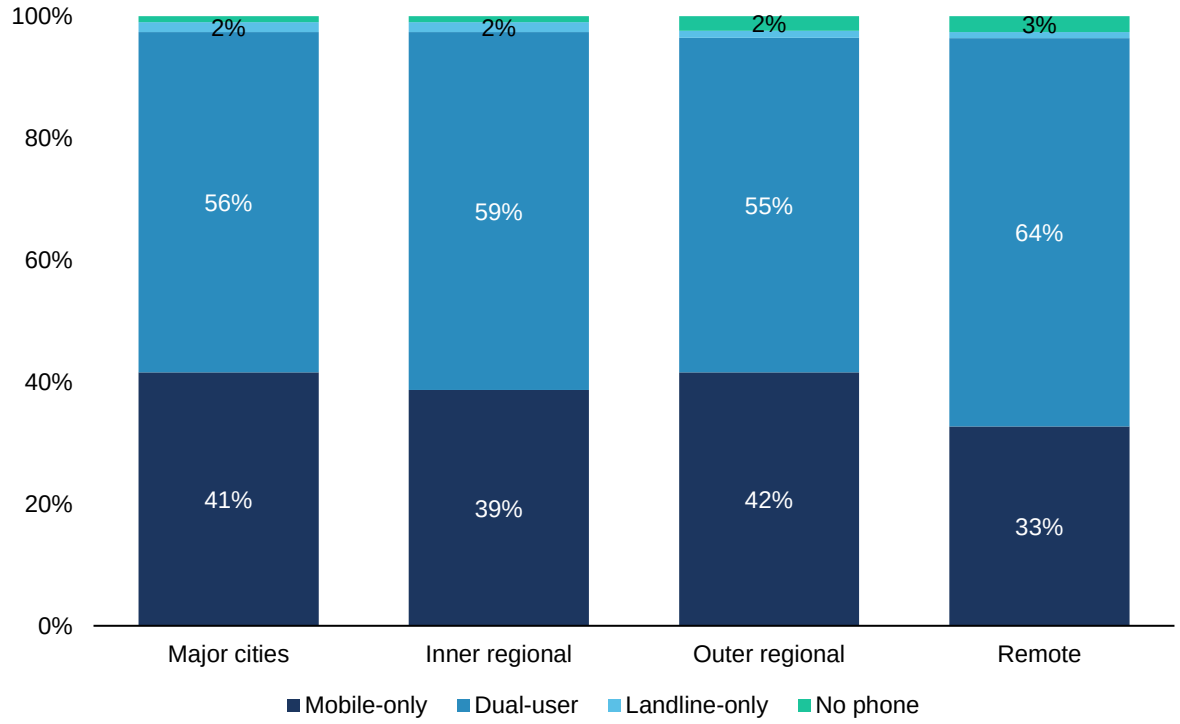
Note: Value labels for 1% and below are suppressed.

Figure 16 Predicted probability of telephone status by capital city/rest of state



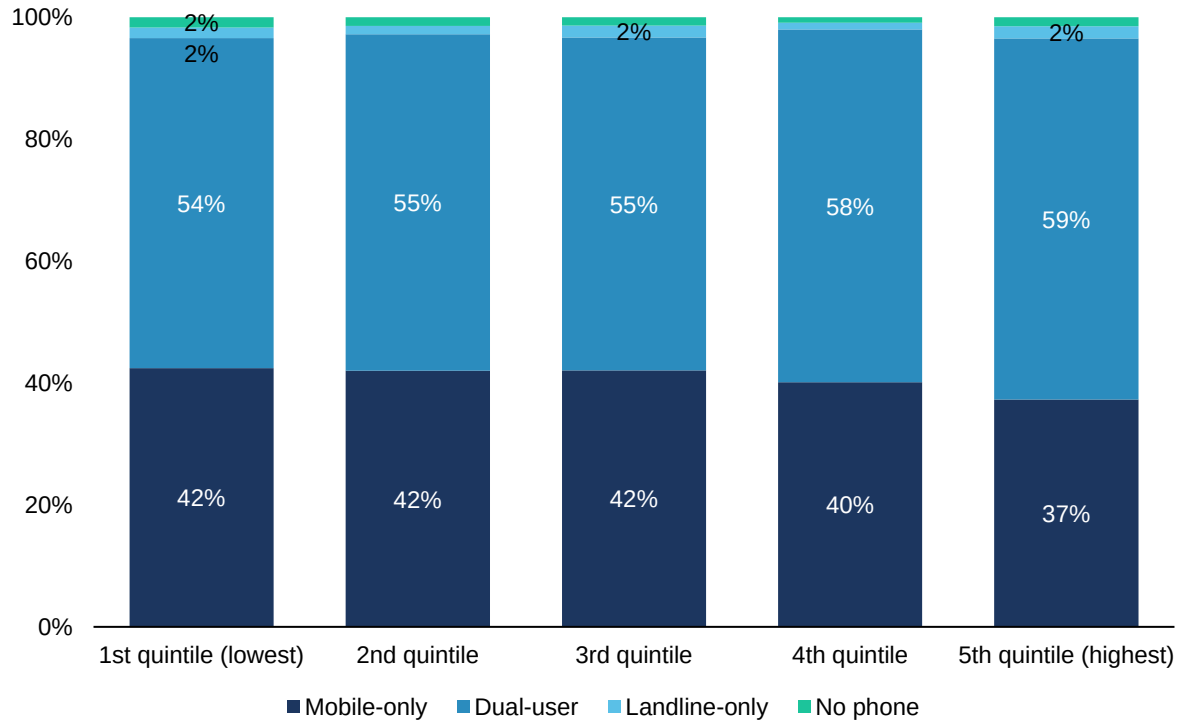
Note: Value labels for 1% and below are suppressed.

Figure 17 Predicted probability of telephone status by remoteness



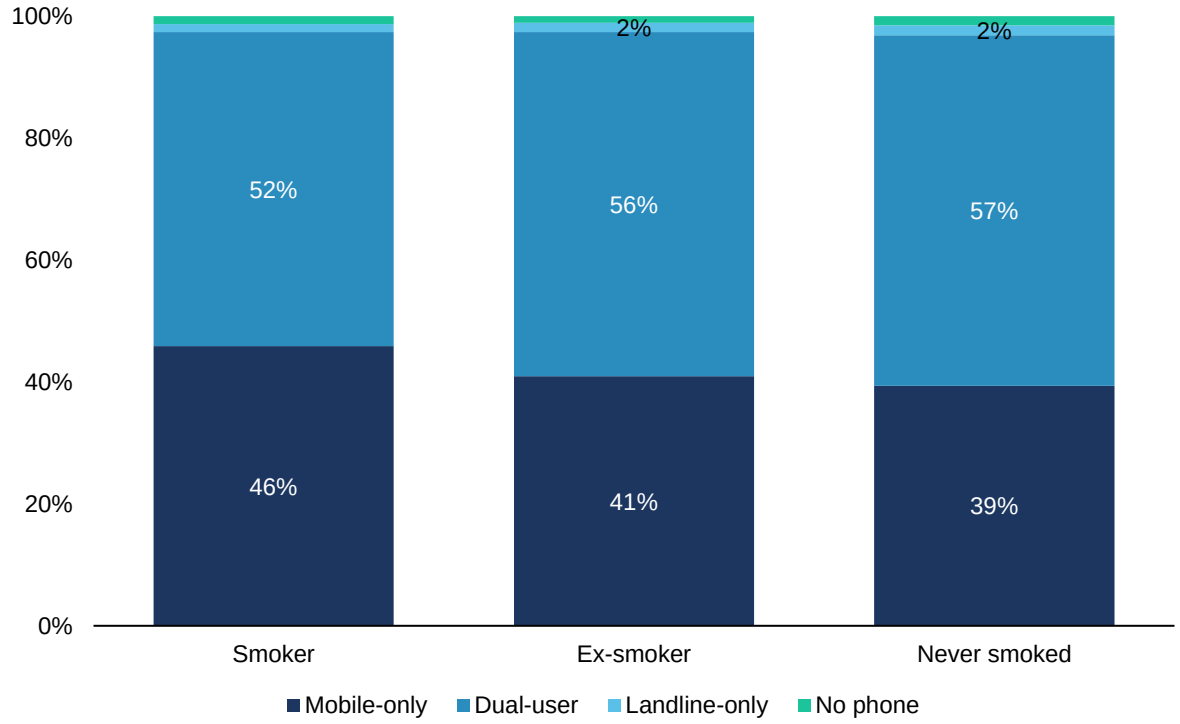
Note: Value labels for 1% and below are suppressed.

Figure 18 Predicted probability of telephone status by SEIFA



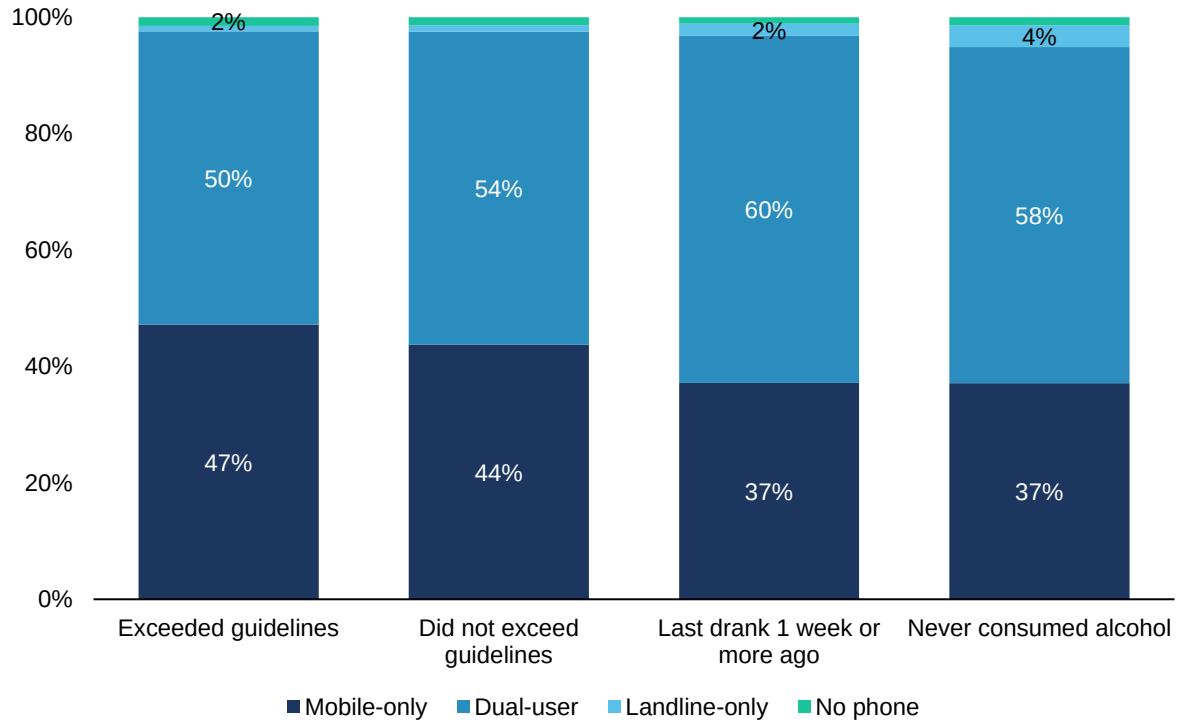
Note: Value labels for 1% and below are suppressed.

Figure 19 Predicted probability of telephone status by smoking status



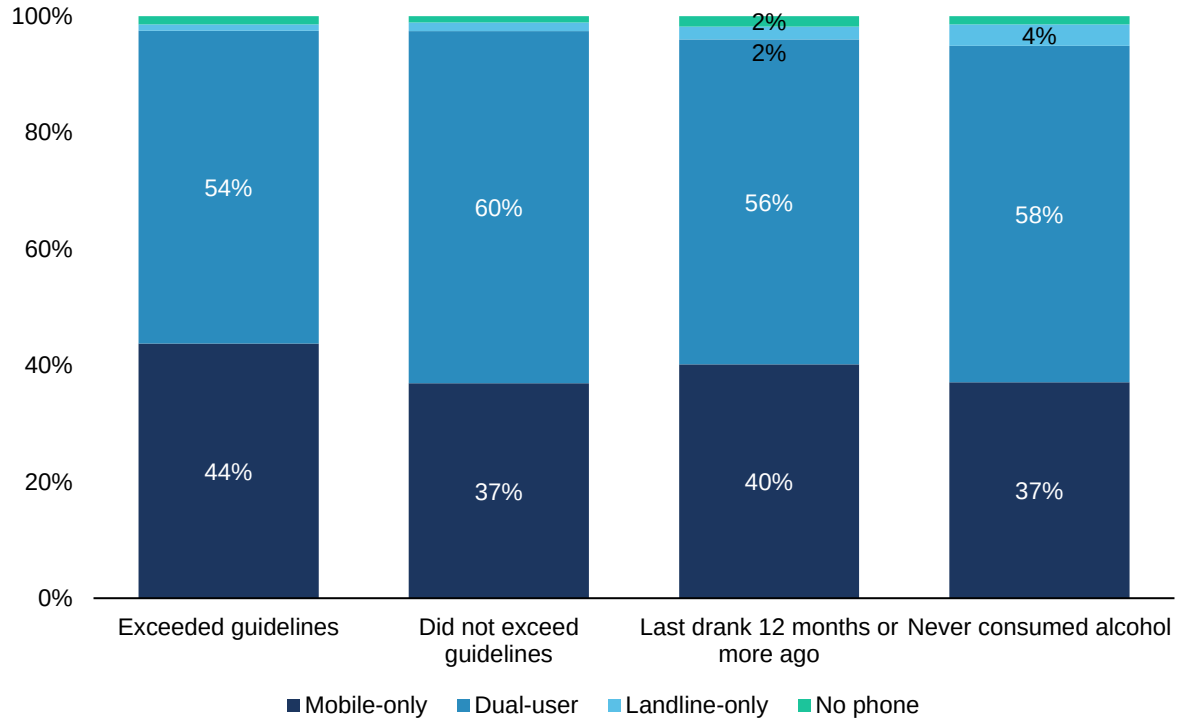
Note: Value labels for 1% and below are suppressed.

Figure 20 Predicted probability of telephone status by lifetime alcohol risk



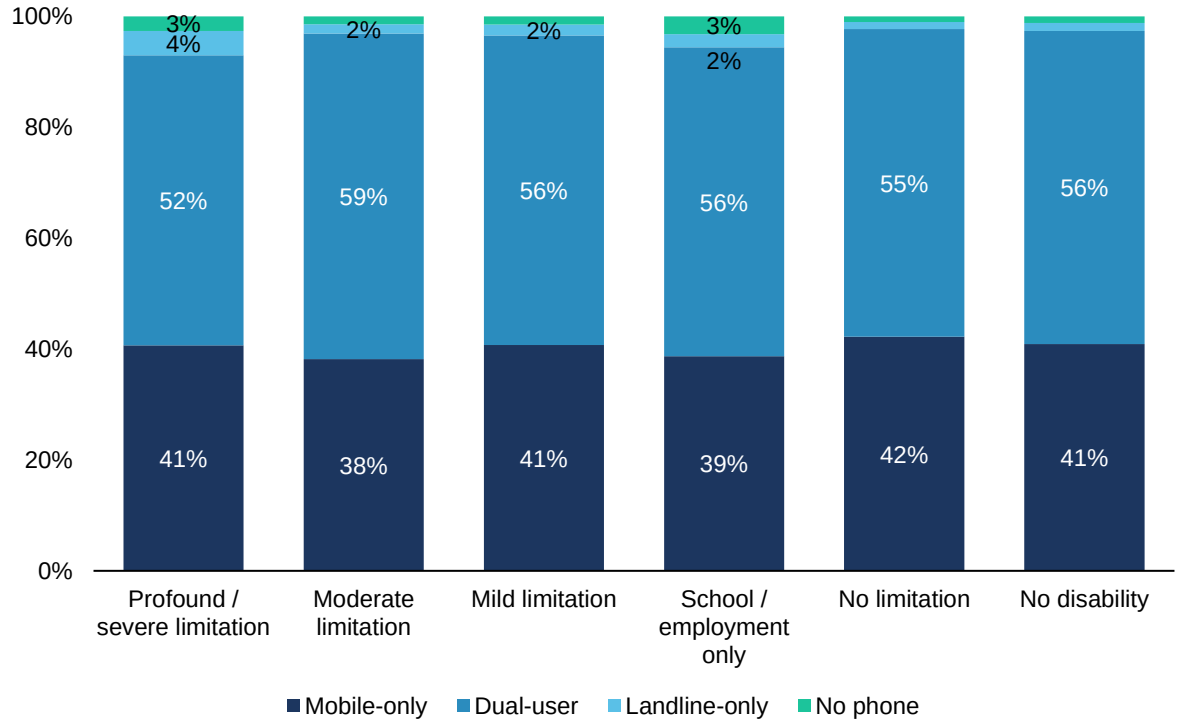
Notes: Value labels for 1% and below are suppressed. Due to the correlation with short-term risk from drinking, short-term alcohol risk is set to the modal value for each lifetime risk category. For adults who exceeded lifetime consumption guidelines, the modal short-term category was exceeded guidelines. For adults who did not exceed lifetime guidelines, the modal short-term risk was exceeded guidelines. For adults who had last drank 1 week or more ago, the modal short-term risk was did not exceed guidelines. For adults who had never consumed alcohol, the modal short-term risk was never having consumed alcohol.

Figure 21 Predicted probability of telephone status by short-term alcohol risk



Notes: Value labels for 1% and below are suppressed. Due to the correlation with lifetime risk from drinking, lifetime alcohol risk is set to the modal value for each short-term risk category. For adults who exceeded short-term consumption guidelines, the modal lifetime category was not exceeding guidelines. For adults who did not exceed short-term guidelines, the modal lifetime risk was not exceeding guidelines. For adults who had last drank 12 months or more ago, the modal lifetime risk was last drank 1 or more weeks ago. For adults who had never consumed alcohol, the modal lifetime risk was never having consumed alcohol.

Figure 22 Predicted probability of telephone status by disability status



Notes: Value labels for 1% and below are suppressed.

Table 28 Relative risk ratios of the multinomial logistic regression of adult telephone use on selected variables

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Mobile-only							
Age							
18-24	-	-	-	-	-	-	-
25-34	1.790***	1.789***	1.558***	2.029***	1.740***	1.720***	1.648***
	(.181)	(.181)	(.162)	(.244)	(.179)	(.212)	(.204)
35-44	.996	1.039	.908	1.001	.976	.945	.906
	(.095)	(.100)	(.091)	(.113)	(.095)	(.113)	(.110)
45-54	.528***	.573***	.434***	.522***	.517***	.459***	.452***
	(.051)	(.056)	(.044)	(.060)	(.051)	(.055)	(.056)
55-64	.404***	.444***	.254***	.395***	.390***	.264***	.266***
	(.039)	(.044)	(.026)	(.046)	(.039)	(.033)	(.035)
65-74	.296***	.325***	.158***	.259***	.286***	.148***	.153***
	(.030)	(.034)	(.018)	(.033)	(.030)	(.021)	(.022)
75+	.125***	.139***	.062***	.105***	.121***	.058***	.062***
	(.016)	(.018)	(.009)	(.016)	(.016)	(.010)	(.011)
Gender							
Male	-	-	-	-	-	-	-
Female	.895*	.887**	.896*	.893*	.885*	.880*	.965
	(.042)	(.041)	(.042)	(.045)	(.042)	(.045)	(.052)
Education							
LT Year 12	-	-	-	-	-	-	-
Year 12	.678***	.678***	.704***	.720***	.720***	.757**	.767**
	(.058)	(.058)	(.061)	(.068)	(.063)	(.073)	(.075)
Dip/Cert	.868*	.873*	.867*	.947	.899	.969	.977
	(.058)	(.058)	(.058)	(.068)	(.061)	(.072)	(.074)
Bachelor's +	.870*	.872*	.874†	.931	1.006	1.036	1.088
	(.060)	(.060)	(.061)	(.071)	(.072)	(.084)	(.091)
Indigenous status							
Not Indigenous	-	-	-	-	-	-	-
Indigenous	2.295***	2.332***	2.276***	2.091***	1.988***	1.905***	1.805**
	(.401)	(.406)	(.401)	(.389)	(.359)	(.366)	(.350)
Language spoken at home							
Other language	-	-	-	-	-	-	-
English	-	1.595***	-	-	-	1.523**	1.423*
		(.203)				(.222)	(.215)
English proficiency							
Main. Eng./v. well	-	-	-	-	-	-	-
Well	-	1.281	-	-	-	1.357†	1.406†
		(.199)				(.239)	(.251)
Not well	-	1.716**	-	-	-	1.850**	1.831**
		(.329)				(.402)	(.402)
Not at all	-	1.722	-	-	-	4.692**	4.651**
		(1.042)				(2.393)	(2.364)
Year of arrival							
Born in Aus.	-	-	-	-	-	-	-
Before 2006	-	.885†	-	-	-	.935	.951
		(.056)				(.065)	(.067)
2006-15	-	1.410***	-	-	-	1.272*	1.315**
		(.132)				(.132)	(.139)
2016-18	-	5.455***	-	-	-	5.731***	5.622***
		(1.286)				(1.477)	(1.555)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Household type							
Family w. kids	-	-	-	-	-	-	-
Couple only	-	-	1.854***	-	-	1.833***	1.795***
			(.124)			(.138)	(.136)
One-person	-	-	3.321***	-	-	3.160***	3.039***
			(.224)			(.233)	(.228)
Other	-	-	.933	-	-	.922	.893
			(.067)			(.079)	(.077)
Labour force status							
Employed	-	-	-	-	-	-	-
Unemployed	-	-	-	.986	-	1.052	1.040
				(.171)		(.192)	(.194)
Not in lab. force	-	-	-	1.058	-	1.068	1.099
				(.079)		(.082)	(.087)
Household income							
1st quartile	-	-	-	-	-	-	-
2nd quartile	-	-	-	.811*	-	.956	.966
				(.070)		(.083)	(.085)
3rd quartile	-	-	-	.610***	-	.733***	.720***
				(.055)		(.068)	(.067)
4th quartile	-	-	-	.646***	-	.770**	.762**
				(.059)		(.075)	(.075)
5th quartile	-	-	-	.728***	-	.842†	.818*
				(.068)		(.084)	(.084)
State/territory							
ACT	-	-	-	-	-	-	-
NSW	-	-	-	-	.697***	.727**	.734**
					(.063)	(.073)	(.074)
VIC	-	-	-	-	.645***	.674***	.675***
					(.060)	(.070)	(.071)
QLD	-	-	-	-	.916	.888	.886
					(.085)	(.091)	(.092)
SA	-	-	-	-	.952	.901	.906
					(.097)	(.100)	(.102)
WA	-	-	-	-	.818*	.797*	.797*
					(.081)	(.088)	(.090)
TAS	-	-	-	-	.986	.989	.982
					(.114)	(.125)	(.126)
NT	-	-	-	-	2.046***	1.972***	2.042***
					(.302)	(.319)	(.333)
GCCSA							
Capital city	-	-	-	-	-	-	-
Rest of state	-	-	-	-	1.245**	1.216*	1.214*
					(.095)	(.100)	(.100)
Remoteness							
Major cities	-	-	-	-	-	-	-
Inner regional	-	-	-	-	.884	.888	.884
					(.073)	(.078)	(.078)
Outer regional	-	-	-	-	1.009	1.047	1.019
					(.110)	(.123)	(.121)
Remote	-	-	-	-	.649*	.748	.689†
					(.126)	(.156)	(.146)
SEIFA							
1st quintile	-	-	-	-	-	-	-
2nd quintile	-	-	-	-	.904	.696	.970
					(.069)	(.079)	(.080)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
3rd quintile	-	-	-	-	.891	.963	.982
					(.069)	(.081)	(.083)
4th quintile	-	-	-	-	.781***	.869	.892
					(.061)	(.074)	(.077)
5th quintile	-	-	-	-	.655***	.788*	.803*
					(.055)	(.074)	(.077)
Smoking status							
Current smoker	-	-	-	-	-	-	-
Ex-smoker	-	-	-	-	-	-	.815*
							(.068)
Never smoked	-	-	-	-	-	-	.770**
							(.064)
Alcohol lifetime risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	.869†
							(.067)
Last drank 1+/wk	-	-	-	-	-	-	.889
							(.082)
Never consumed	-	-	-	-	-	-	.686***
							(.080)
Alcohol short term risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	.750***
							(.051)
Last drank 12/mo	-	-	-	-	-	-	.867
							(.101)
Never consumed	-	-	-	-	-	-	-
Disability status							
Profound/severe	-	-	-	-	-	-	-
Moderate	-	-	-	-	-	-	.836
							(.131)
Mild	-	-	-	-	-	-	.937
							(.141)
Schooling/employ	-	-	-	-	-	-	.891
							(.152)
No limitation	-	-	-	-	-	-	.978
							(.139)
No disability	-	-	-	-	-	-	.929
							(.121)
Intercept	1.331**	.789	1.247*	1.769***	1.933***	1.145	1.947*
	(.134)	(.127)	(.139)	(.244)	(.260)	(.252)	(.526)
Dual-user	-	-	-	-	-	-	-
Landline-only							
Age							
18-24	-	-	-	-	-	-	-
25-34	.845	.828	.952	1.544	.835	1.690	1.696
	(.407)	(.397)	(.465)	(.920)	(.404)	(1.008)	(1.005)
35-44	.744	.706	.958	.955	.741	1.105	1.089
	(.298)	(.285)	(.390)	(.516)	(.297)	(.601)	(.598)
45-54	1.695	1.674	1.942†	2.398†	1.738	2.476†	2.305†
	(.606)	(.605)	(.697)	(1.199)	(.622)	(1.224)	(1.164)
55-64	2.367*	2.333*	2.527**	2.249†	2.358*	1.998	2.102
	(.818)	(.820)	(.889)	(1.091)	(.817)	(.981)	(1.059)
65-74	4.342***	4.393***	4.971***	2.858*	4.383***	2.726*	3.101*
	(1.429)	(1.477)	(1.703)	(1.378)	(1.443)	(1.331)	(1.557)
75+	14.492***	14.151***	15.489***	8.021***	14.550***	7.105***	7.254***
	(4.713)	(4.725)	(5.290)	(3.839)	(4.736)	(3.466)	(3.655)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Gender							
Male	-	-	-	-	-	-	-
Female	.994	.997	.936	1.001	.983	.966	.762*
	(.098)	(.099)	(.093)	(.108)	(.097)	(.106)	(.089)
Education							
LT Year 12	-	-	-	-	-	-	-
Year 12	.630**	.629**	.632**	.643*	.662*	.661*	.659*
	(.107)	(.109)	(.106)	(.119)	(.112)	(.126)	(.127)
Dip/Cert	.443***	.460***	.457***	.477***	.461***	.498***	.494***
	(.055)	(.058)	(.057)	(.066)	(.058)	(.070)	(.072)
Bachelor's +	.255***	.262***	.272***	.376***	.285***	.411***	.434***
	(.041)	(.042)	(.044)	(.064)	(.047)	(.070)	(.079)
Indigenous status							
Not Indigenous	-	-	-	-	-	-	-
Indigenous	1.368	1.444	1.339	1.087	1.230	1.043	.980
	(.613)	(.643)	(.597)	(.508)	(.569)	(.481)	(.488)
Language spoken at home							
Other language	-	-	-	-	-	-	-
English	-	.628	-	-	-	.554	.630
		(.220)				(.214)	(.246)
English proficiency							
Main. Eng./v. well	-	-	-	-	-	-	-
Well	-	1.075	-	-	-	.778	.816
		(.199)				(.239)	(.251)
Not well	-	1.428	-	-	-	1.076	1.039
		(.578)				(.478)	(.471)
Not at all	-	1.716	-	-	-	.866	.535
		(.431)				(.349)	(.362)
Year of arrival							
Born in Aus.	-	-	-	-	-	-	-
Before 2006	-	.852	-	-	-	.939	.923
		(.102)				(.122)	(.127)
2006-15	-	.778	-	-	-	.666	.632
		(.278)				(.311)	(.294)
2016-18	-	.164†	-	-	-	.219	.238
		(.176)				(.236)	(.256)
Household type							
Family w. kids	-	-	-	-	-	-	-
Couple only	-	-	1.099	-	-	1.418	1.286
			(.264)			(.392)	(.357)
One-person	-	-	2.119**	-	-	2.372**	2.239**
			(.511)			(.653)	(.616)
Other	-	-	1.960**	-	-	2.148**	1.869*
			(.462)			(.629)	(.538)
Labour force status							
Employed	-	-	-	-	-	-	-
Unemployed	-	-	-	.516	-	.459	.435
				(.312)		(.279)	(.272)
Not in lab. force	-	-	-	2.337***	-	2.229***	1.690*
				(.499)		(.476)	(.336)
Household income							
1st quartile	-	-	-	-	-	-	-

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
2nd quartile	-	-	-	.905	-	.942	.992
				(.108)		(.114)	(.125)
3rd quartile	-	-	-	.591**	-	.627**	.689*
				(.100)		(.113)	(.127)
4th quartile	-	-	-	.560**	-	.579*	.721
				(.124)		(.134)	(.170)
5th quartile	-	-	-	.487**	-	.516*	.675
				(.126)		(.143)	(.193)
State/territory							
ACT	-	-	-	-	-	-	-
NSW	-	-	-	-	.649*	.556**	.604*
					(.133)	(.121)	(.137)
VIC	-	-	-	-	.692†	.555**	.574*
					(.147)	(.126)	(.135)
QLD	-	-	-	-	.704†	.636*	.622*
					(.147)	(.142)	(.146)
SA	-	-	-	-	.779	.701	.722
					(.176)	(.167)	(.184)
WA	-	-	-	-	.591*	.623*	.697
					(.130)	(.149)	(.177)
TAS	-	-	-	-	.763	.703	.732
					(.186)	(.181)	(.202)
NT	-	-	-	-	1.318	.943	1.034
					(.440)	(.344)	(.416)
GCCSA							
Capital city	-	-	-	-	-	-	-
Rest of state	-	-	-	-	1.158	1.429†	1.558*
					(.185)	(.264)	(.304)
Remoteness							
Major cities	-	-	-	-	-	-	-
Inner regional	-	-	-	-	.924	.968	.907
					(.147)	(.170)	(.170)
Outer regional	-	-	-	-	.713	.818	.706
					(.152)	(.194)	(.184)
Remote	-	-	-	-	.546	.596	.553
					(.207)	(.254)	(.268)
SEIFA							
1st quintile	-	-	-	-	-	-	-
2nd quintile	-	-	-	-	.678**	.743*	.794
					(.093)	(.108)	(.123)
3rd quintile	-	-	-	-	.778†	.999	1.102
					(.115)	(.157)	(.183)
4th quintile	-	-	-	-	.429***	.557**	.612*
					(.072)	(.103)	(.117)
5th quintile	-	-	-	-	.593**	1.002	1.098
					(.101)	(.192)	(.224)
Smoking status							
Current smoker	-	-	-	-	-	-	-
Ex-smoker	-	-	-	-	-	-	1.069
							(.197)
Never smoked	-	-	-	-	-	-	1.134
							(.211)
Alcohol lifetime risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	1.236
							(.269)
Last drank 1+/wk	-	-	-	-	-	-	1.786*
							(.432)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Never consumed	-	-	-	-	-	-	3.793***
							(.997)
Alcohol short term risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	1.179
							(.225)
Last drank 12/mo	-	-	-	-	-	-	1.281
							(.312)
Never consumed	-	-	-	-	-	-	-
Disability status							
Profound/severe	-	-	-	-	-	-	-
Moderate	-	-	-	-	-	-	.341***
							(.072)
Mild	-	-	-	-	-	-	.420***
							(.078)
Schooling/employ	-	-	-	-	-	-	.508*
							(.168)
No limitation	-	-	-	-	-	-	.277***
							(.063)
No disability	-	-	-	-	-	-	.302***
							(.057)
Intercept	.047***	.073***	.029***	.039***	.098***	.074***	.098
	(.016)	(.034)	(.011)	(.020)	(.038)	(.053)	(.076)
No phone							
Age							
18-24	-	-	-	-	-	-	-
25-34	1.902*	1.779†	1.926*	1.767†	1.712†	1.483	1.422
	(.561)	(.536)	(.596)	(.587)	(.500)	(.517)	(.500)
35-44	1.640†	1.656†	1.849*	1.440	1.539	1.562	1.491
	(.459)	(.473)	(.572)	(.458)	(.429)	(.549)	(.540)
45-54	.919	.984	.912	.677	.870	.628	.603
	(.291)	(.317)	(.315)	(.233)	(.271)	(.243)	(.237)
55-64	.611	.663	.497*	.284***	.561	.191***	.189***
	(.187)	(.211)	(.170)	(.098)	(.172)	(.073)	(.075)
65-74	1.033	1.095	.780	.446*	.962	.261***	.283**
	(.314)	(.331)	(.293)	(.162)	(.293)	(.109)	(.125)
75+	.793	.847	.556	.318**	.742	.184***	.216***
	(.254)	(.276)	(.213)	(.121)	(.238)	(.081)	(.102)
Gender							
Male	-	-	-	-	-	-	-
Female	.775†	.752*	.777†	.606**	.771†	.601**	.630*
	(.111)	(.108)	(.112)	(.102)	(.111)	(.101)	(.115)
Education							
LT Year 12	-	-	-	-	-	-	-
Year 12	.581*	.566*	.606*	.604*	.614*	.576*	.595*
	(.138)	(.131)	(.145)	(.155)	(.146)	(.142)	(.149)
Dip/Cert	.403***	.433***	.418***	.452***	.430***	.481***	.495**
	(.075)	(.082)	(.078)	(.094)	(.081)	(.101)	(.106)
Bachelor's +	.404***	.399***	.429***	.541*	.492***	.558*	.584†
	(.081)	(.085)	(.087)	(.139)	(.104)	(.162)	(.175)
Indigenous status							
Not Indigenous	-	-	-	-	-	-	-
Indigenous	4.403***	4.916***	4.326***	4.604***	3.346***	4.086***	3.991***
	(1.398)	(1.576)	(1.390)	(1.544)	(1.074)	(1.465)	(1.436)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Language spoken at home							
Other language	-	-	-	-	-	-	-
English	-	.717	-	-	-	.720	.704
		(.269)				(.259)	(.262)
English proficiency							
Main. Eng./v. well	-	-	-	-	-	-	-
Well	-	.857	-	-	-	.729	.794
		(.389)				(.326)	(.353)
Not well	-	1.304	-	-	-	.846	.873
		(.641)				(.422)	(.426)
Not at all	-	4.872*	-	-	-	7.886**	8.301**
		(3.230)				(5.475)	(5.696)
Year of arrival							
Born in Aus.	-	-	-	-	-	-	-
Before 2006	-	.865	-	-	-	.981	1.027
		(.164)				(.210)	(.223)
2006-15	-	1.165	-	-	-	1.299	1.372
		(.327)				(.398)	(.426)
2016-18	-	5.585***	-	-	-	8.962***	10.042***
		(2.501)				(4.320)	(4.702)
Household type							
Family w. kids	-	-	-	-	-	-	-
Couple only	-	-	1.658*	-	-	2.331**	2.247
			(.403)			(.665)	(.644)
One-person	-	-	3.049***	-	-	4.206***	4.004
			(.673)			(1.021)	(.993)
Other	-	-	1.530†	-	-	1.442	1.304
			(.346)			(.415)	(.371)
Labour force status							
Employed	-	-	-	-	-	-	-
Unemployed	-	-	-	.574	-	.575	.496**
				(.291)		(.305)	(.267)
Not in lab. force	-	-	-	1.951***	-	1.926**	1.672***
				(.388)		(.412)	(.389)
Household income							
1st quartile	-	-	-	-	-	-	-
2nd quartile	-	-	-	.921	-	1.074	1.027
				(.206)		(.246)	(.237)
3rd quartile	-	-	-	.648	-	.803	.807
				(.179)		(.234)	(.233)
4th quartile	-	-	-	.481*	-	.629	.656
				(.147)		(.223)	(.231)
5th quartile	-	-	-	.432*	-	.538	.532
				(.146)		(.216)	(.212)
State/territory							
ACT	-	-	-	-	-	-	-
NSW	-	-	-	-	.365***	.272***	.289***
					(.107)	(.085)	(.093)
VIC	-	-	-	-	.705	.515*	.550†
					(.191)	(.156)	(.169)
QLD	-	-	-	-	.748	.543*	.562†
					(.196)	(.158)	(.166)
SA	-	-	-	-	.319***	.317***	.335**
					(.107)	(.113)	(.121)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
WA	-	-	-	-	.528*	.468*	.521†
					(.163)	(.155)	(.176)
TAS	-	-	-	-	.167***	.201***	.206***
					(.068)	(.085)	(.090)
NT	-	-	-	-	1.455	1.730	1.819
					(.583)	(.727)	(.789)
GCCSA							
Capital city	-	-	-	-	-	-	-
Rest of state	-	-	-	-	.975	1.200	1.159
					(.318)	(.399)	(.395)
Remoteness							
Major cities	-	-	-	-	-	-	-
Inner regional	-	-	-	-	.786	.653	.682
					(.309)	(.272)	(.285)
Outer regional	-	-	-	-	2.419*	1.689	1.782
					(.836)	(.611)	(.662)
Remote	-	-	-	-	1.904	1.685	1.679
					(.917)	(.903)	(.908)
SEIFA							
1st quintile	-	-	-	-	-	-	-
2nd quintile	-	-	-	-	.756	.793	.817
					(.153)	(.175)	(.182)
3rd quintile	-	-	-	-	.713†	.754	.772
					(.138)	(.170)	(.174)
4th quintile	-	-	-	-	.456***	.458**	.476**
					(.102)	(.120)	(.125)
5th quintile	-	-	-	-	.443**	.723	.782
					(.114)	(.225)	(.245)
Smoking status							
Current smoker	-	-	-	-	-	-	-
Ex-smoker	-	-	-	-	-	-	.829
							(.197)
Never smoked	-	-	-	-	-	-	1.054
							(.222)
Alcohol lifetime risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	.873
							(.238)
Last drank 1+/wk	-	-	-	-	-	-	.907
							(.279)
Never consumed	-	-	-	-	-	-	.786
							(.253)
Alcohol short term risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	.675
							(.163)
Last drank 12/mo	-	-	-	-	-	-	1.182
							(.411)
Never consumed	-	-	-	-	-	-	-
Disability status							
Profound/severe	-	-	-	-	-	-	-
Moderate	-	-	-	-	-	-	.466*
							(.179)
Mild	-	-	-	-	-	-	.525†
							(.178)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Schooling/employ	-	-	-	-	-	-	1.169
							(.471)
No limitation	-	-	-	-	-	-	.378**
							(.141)
No disability	-	-	-	-	-	-	.441**
							(.135)
Intercept	.071***	.087***	.048***	.104***	.182***	.217*	.542
	(.021)	(.036)	(.018)	(.038)	(.075)	(.130)	(.397)
F	53.835	34.512	49.711	32.719	28.297	18.275	15.252
DF	33	54	42	51	78	126	162
p	.000	.000	.000	.000	.000	.000	.000
n	15,573	15,748	15,753	13,640	15,753	13,636	13,427

† $p \leq .1$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

9.2. Mobile phone status

Having a mobile phone (regardless of access to a landline phone) is associated with age, gender, education, whether English is spoken at home, household type, labour force status, state/territory by capital city rest of state and area-level socio-economic status. As the model output for the logistic regression model is easier to interpret than for the multinomial logit model used for telephone use, we do not show figures containing model estimates. The results are summarised below. Except where otherwise specified, all other variables in the model are set to their means:

- Age is strongly associated with mobile access, holding other factors constant. Adults under the age of 65 had an estimated probability of having a mobile phone of 96% or greater (age 18-24: 97%; age 25-34: 98%; age 35-44: 97%; age 45-54: 96%; age 55-64: 96%), dropping slightly to 94% for adults aged 65-74 and then more sharply to 85% for adults aged 75 and over.
- Gender was weakly associated with mobile access after other variables were controlled for, with males having a predicted probability of having a mobile phone of 96% compared to 97% for females.
- Holding other factors constant, higher levels of education are associated with increased likelihood of mobile phone access. The estimated probability of having a mobile phone is 94% for adults with less than Year 12 education, 95% for adults with Year 12 education and 97% for adults with a Certificate III/IV, Diploma or Advanced Diploma or with a Bachelor's degree or above.
- Speaking a language other than English at home is associated with slightly lower likelihood of using a mobile phone, holding other factors constant. The expected probability of having a mobile phone is 96% for those who speak only English at home and 95% for those who speak a language other than English.
- There are also small variations in the likelihood of mobile phone access by household type, controlling for other factors. Adults in family households with children are estimated to have a 97% probability of having a mobile phone, as are adults in couple-only family households. Adults from one-person households and other types of households have a 95% probability of having a mobile phone.
- Mobile phone access also varies somewhat by labour force status. Adults who are employed are estimated to have a 97% probability of having a mobile phone, holding all other factors constant, as compared to a 98% likelihood for adults who are unemployed and 95% for adults who are not in the labour force.

- There are variations in mobile phone access by state and capital city/rest of state, controlling for other factors. As the interaction of these variables is significant but with small sample sizes in some states, we use the same categories as found in Table 2. The probability of using a mobile phone is estimated to be 97% in Sydney, 96% in the rest of NSW, 95% in Melbourne, 96% in the rest of Victoria, 97% in Brisbane, 94% in the rest of Queensland, 96% in South Australia, 96% in Western Australia, 97% in Tasmania, 92% in the Northern Territory and 95% in the ACT.
- Mobile phone access varies slightly by area-level socio-economic status, holding other factors constant. The likelihood of having a mobile phone is estimated as 96% for adults in the lowest socio-economic status quintile, 96% in the second quintile, 96% in the third quintile, 97% in the fourth quintile and 96% in the highest socio-economic status quintile.
- Alcohol consumption is associated with mobile access. Adults who exceed lifetime alcohol risk guidelines have an estimated 97% probability of having a mobile phone, holding other factors constant, as do adults who consume alcohol but do not exceed the guidelines. Adults who consumed alcohol more than 1 week ago have a 96% probability of having a mobile phone and adults who have never consumed alcohol have a 94% probability of having a mobile phone.[18] Adults who exceed the short-term risk guidelines have an estimated 97% probability of having a mobile phone, controlling for other variables.[19] Adults who did not exceed the short-term risk guidelines also have an estimated 97% probability of having a mobile phone. Adults who last consumed alcohol 1 year or more ago have an estimated 94% probability of having a mobile phone, as do adults who never consumed alcohol.
- Disability status is associated with mobile use, holding all other factors constant. Adults with profound or severe activity restrictions have an estimated 92% probability of having a mobile phone. Adults with moderate restrictions had a 97% probability of using a mobile phone, with this statistic being 96% for adults with mild restrictions, 95% for adults with schooling or employment restrictions only, 97% for adults with no restrictions and 96% for adults who do not have a disability.
- Mobile phone access also varies slightly with self-assessed health, controlling for other factors. Adults who rate their health as poor have an estimated 95% probability of having a mobile phone, as do adults who rate their health as fair. Adults who rate their health as good, very good or excellent have an estimated 96% probability of having a mobile phone.

Table 29 Odds ratios of the logistic regression of mobile telephone access on selected variables

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age							
18-24	-	-	-	-	-	-	-

[18] Because of the correlation between lifetime and short-term alcohol risk, short-term risk is set to the modal category for each level of lifetime risk. For adults who exceed lifetime risk guidelines, the modal short-term risk is exceeding guidelines. For adults who do not exceed lifetime risk guidelines, the modal short-term risk is exceeding guidelines. For adults who consumed alcohol more than 1 week ago, the modal short-term risk category is not exceeding the guidelines. For adults who have never consumed alcohol, the modal short-term risk category is never having consumed alcohol.

[19] Lifetime risk is set to the modal category for each level of short-term risk. For adults who exceed short-term guidelines, the modal level of lifetime risk is not exceeding guidelines. For adults who do not exceed short-term risk guidelines, the modal level of lifetime risk is not exceeding guidelines. For adults who last consumed alcohol more than 1 year ago, the modal level of lifetime risk is last consumed alcohol more than 1 week ago. For adults have never consumed alcohol, the modal level of lifetime risk is never having consumed alcohol.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
25-34	.949	1.000	.833	.914	.994	.968	1.015
	(.230)	(.242)	(.207)	(.260)	(.241)	(.242)	(.256)
35-44	.779	.815	.636†	.782	.798	.746	.810
	(.177)	(.186)	(.151)	(.212)	(.180)	(.176)	(.196)
45-54	.612*	.620*	.538**	.613†	.605*	.594*	.665†
	(.140)	(.142)	(.127)	(.060)	(.138)	(.138)	(.160)
55-64	.519**	.517**	.464***	.729	.526**	.604*	.653†
	(.114)	(.114)	(.106)	(.191)	(.115)	(.140)	(.162)
65-74	.263***	.259***	.216***	.471**	.261***	.366***	.377***
	(.054)	(.054)	(.048)	(.121)	(.054)	(.086)	(.094)
75+	.082***	.082***	.071***	.166***	.081***	.129***	.145***
	(.017)	(.017)	(.016)	(.042)	(.016)	(.030)	(.037)
Gender							
Male	-	-	-	-	-	-	-
Female	1.057	1.061	1.089	1.124	1.058	1.158†	1.292**
	(.086)	(.087)	(.089)	(.101)	(.087)	(.097)	(.116)
Education							
LT Year 12	-	-	-	-	-	-	-
Year 12	1.466**	1.524**	1.456**	1.445*	1.443***	1.426**	1.354*
	(.202)	(.209)	(.199)	(.215)	(.198)	(.194)	(.189)
Dip/Cert	2.281***	2.219***	2.203***	2.155***	2.212***	1.961***	1.858***
	(.236)	(.230)	(.226)	(.245)	(.230)	(.205)	(.200)
Bachelor's +	3.114***	3.243***	2.938***	2.307***	2.841***	2.529***	2.266***
	(.386)	(.407)	(.366)	(.326)	(.362)	(.328)	(.306)
Indigenous status							
Not Indigenous	-	-	-	-	-	-	-
Indigenous	.586*	.534*	.602†	.621†	.682	-	-
	(.153)	(.140)	(.406)	(.171)	(.184)		
Language spoken at home							
Other language	-	-	-	-	-	-	-
English	-	1.816***	-	-	-	1.653***	1.478**
		(.212)				(.214)	(.201)
Household type							
Family w. kids	-	-	-	-	-	-	-
Couple only	-	-	1.042	-	-	1.021	1.032
			(.170)			(.170)	(.176)
One-person	-	-	.649**	-	-	.647**	.660**
			(.100)			(.101)	(.104)
Other	-	-	.577***	-	-	.599***	.649**
			(.090)			(.094)	(.102)
Labour force status							
Employed	-	-	-	-	-	-	-
Unemployed	-	-	-	1.878	-	1.796	2.064†
				(.730)		(.668)	(.777)
Not in lab. force	-	-	-	.493***	-	.489***	.646***
				(.072)		(.058)	(.081)
Household income							
1st quartile	-	-	-	-	-	-	-
2nd quartile	-	-	-	1.037	-	-	-
				(.110)			
3rd quartile	-	-	-	1.406*	-	-	-
				(.199)			
4th quartile	-	-	-	1.648**	-	-	-
				(.287)			

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
5th quartile	-	-	-	1.951***	-	-	-
				(.387)			
State/territory × GCCSA							
Sydney	-	-	-	-	-	-	-
Rest of NSW	-	-	-	-	.943	.744†	.696*
					(.162)	(.130)	(.124)
Melbourne	-	-	-	-	.666**	.647**	.624***
					(.097)	(.094)	(.092)
Rest of VIC	-	-	-	-	1.029	.819	.796
					(.221)	(.180)	(.178)
Brisbane	-	-	-	-	1.169	1.042	1.116
					(.198)	(.175)	(.188)
Rest of QLD	-	-	-	-	.607***	.474***	.474***
					(.091)	(.074)	(.077)
SA	-	-	-	-	.975	.826	.811
					(.150)	(.127)	(.128)
WA	-	-	-	-	.967	.826	.766†
					(.150)	(.129)	(.122)
TAS	-	-	-	-	1.122	.873	.879
					(.173)	(.137)	(.144)
NT	-	-	-	-	.420***	.346***	.338***
					(.073)	(.059)	(.060)
ACT	-	-	-	-	.594**	.569***	.575**
					(.105)	(.100)	(.104)
SEIFA							
1st quintile	-	-	-	-	-	-	-
2nd quintile	-	-	-	-	1.349**	1.275*	1.174
					(.155)	(.148)	(.140)
3rd quintile	-	-	-	-	1.263*	1.112	1.001
					(.147)	(.131)	(.122)
4th quintile	-	-	-	-	2.137***	1.852***	1.645***
					(.290)	(.255)	(.232)
5th quintile	-	-	-	-	1.618***	1.295†	1.125
					(.230)	(.188)	(.168)
Alcohol lifetime risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	.984
							(.146)
Last drank 1+/wk	-	-	-	-	-	-	.833
							(.140)
Never consumed	-	-	-	-	-	-	.479***
							(.084)
Alcohol short term risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	.888
							(.114)
Last drank 12/mo	-	-	-	-	-	-	.641*
							(.115)
Never consumed	-	-	-	-	-	-	-
Disability status							
Profound/severe	-	-	-	-	-	-	-
Moderate	-	-	-	-	-	-	2.323***
							(.412)
Mild	-	-	-	-	-	-	1.911***
							(.306)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Schooling/employ	-	-	-	-	-	-	1.462
							(.352)
No limitation	-	-	-	-	-	-	2.440***
							(.461)
No disability	-	-	-	-	-	-	2.190***
							(.359)
Self-assessed health							
Poor	-	-	-	-	-	-	-
Fair	-	-	-	-	-	-	.916
							(.161)
Good	-	-	-	-	-	-	1.331
							(.113)
Very good	-	-	-	-	-	-	1.310
							(.253)
Excellent	-	-	-	-	-	-	1.291
							(.276)
Intercept	18.878***	11.231***	27.878***	17.973***	16.227***	20.764***	10.815***
	(3.914)	(2.457)	(6.931)	(4.907)	(3.785)	(5.866)	(3.936)
F	77.89	72.13	64.94	45.07	36.29	33.16	24.06
Model DF	11	12	14	17	25	30	44
p	.000	.000	.000	.000	.000	.000	.000
n	15,793	15,792	15,793	13,664	15,793	15,792	15,551

† $p \leq .1$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

9.3. Landline phone status

Access to a landline phone (regardless of mobile phone access) is associated with age, education, Indigenous status, language spoken at home, proficiency in spoken English, year of arrival in Australia, household type, household income, state/territory and capital city/rest of state, smoking status and alcohol use (Table 30). The results are summarised below. Except where otherwise specified, all other variables in the model are set to their means:

- Age is very strongly associated with landline access, controlling for other variables. Estimated probabilities of landline access by age group are 40% for 18 to 24 year-olds, 29% for 25 to 34 year-olds, 43% for 35 to 44 year-olds, 60% for 45 to 54 year-olds, 72% for 55 to 64 year-olds, 81% for 65 to 74 year-olds and 92% for adults aged 75 and above.
- Education is also associated with landline access, holding all other variables constant. Landline access is greatest for adults with Year 12 education, with an estimated probability of access of 64%. Adults with less than Year 12 education or a Certificate III/IV or Diploma or Advanced Diploma have an estimated probability of having landline access of 58%. The estimated probability of landline access is 56% for adults with a Bachelor's degree or higher.
- Landline access varies by Indigenous status. Indigenous adults have an estimated likelihood of landline access of 42%, holding all other factors constant, compared to 59% for non-Indigenous adults.
- Adults who speak a language other than English have an estimated probability of having landline access of 64%, controlling for other variables, compared to 57% for adults who only speak English.
- Proficiency in spoken English is strongly associated with landline access, holding all other factors constant. Adults who do not speak English are estimated to have a 20% likelihood of landline access. This increases to 45% for adults who do not speak English well, 51% for

adults who speak English well or very well and 59% for adults who mainly speak English at home.

- Year of arrival is also a predictor of landline access. Adults who were born in Australia have an estimated probability of having a landline in their household of 60%, controlling for other factors. Adults who migrated to Australia before 2006 have an estimated probability of having a landline phone of 61%. This figure drops to 52% for adults who arrived in Australia between 2006 and 2015 and is only 19% for adults who arrived between 2016 and 2018.
- Household type is associated with landline access. Adults in family households with children have an estimated 66% probability of having landline access, holding all other factors constant. Adults in couple only family households have an estimated 52% probability of having a landline phone. Adults in one-person households had the lowest likelihood of having a landline phone, at 40%. Other types of households have an estimated 69% probability of having a landline phone.
- Household income has a modest degree of association with landline access. Adults in the lowest household income quintile have an estimated 53% likelihood of having a landline phone, holding all other factors constant, while those in the second lowest household income quintile have a 54% likelihood. Adults in the middle and second highest quintiles have a 61% likelihood. Adults in the highest household income quintile have a 60% likelihood of having a landline phone in their household.
- State or territory and capital city/rest of state is associated with landline access. Adults in Sydney and the rest of NSW both have an estimated probability of having a landline phone in their household of 60%, controlling for other variables. Adults from Melbourne have the highest estimated probability of landline access (64%), while the probability for the rest of Victoria is 55%. In Queensland, adults from Brisbane have a 57% probability and those in the rest of the state have a 62% probability. For the other states and territories, the expected probabilities are 55% for South Australia, 58% for Western Australia, 53% for Tasmania, 35% for the Northern Territory and 54% for the ACT.
- Smokers are estimated to have a 53% probability of having a landline phone in their household, holding other variables constant, compared to a 58% probability for ex-smokers and 60% probability for non-smokers.
- Alcohol consumption is associated with having access to a landline phone. Adults who exceed lifetime alcohol risk guidelines have an estimated 52% probability of landline access, holding other factors constant. Adults who consume alcohol but do not exceed the guidelines have an estimated 56% probability of landline access. Adults who consumed alcohol more than 1 week ago and adults who have never consumed alcohol have an estimated 62% probability of having a landline phone in their household.[20] Adults who exceed the short-term risk guidelines have an estimated 56% probability of having a landline phone in their household, controlling for other variables.[21] Adults who do not exceed the short-term risk

[20] Because of the correlation between lifetime and short-term alcohol risk, short-term risk is set to the modal category for each level of lifetime risk. For adults who exceed lifetime risk guidelines, the modal short-term risk is exceeding guidelines. For adults who do not exceed lifetime risk guidelines, the modal short-term risk is exceeding guidelines. For adults who consumed alcohol more than 1 week ago, the modal short-term risk category is not exceeding the guidelines. For adults who have never consumed alcohol, the modal short-term risk category is never having consumed alcohol.

[21] Lifetime risk is set to the modal category for each level of short-term risk. For adults who exceed short-term guidelines, the modal level of lifetime risk is not exceeding guidelines. For adults who do not exceed short-term risk guidelines, the modal level of lifetime risk is not exceeding guidelines. For adults who last consumed alcohol

guidelines have an estimated 62% probability of having landline access. Adults who last consumed alcohol 1 year or more ago have an estimated 58% probability of having a landline phone in their household.

Table 30 Odds ratios of the logistic regression of landline access on selected variables

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age							
18-24	-	-	-	-	-	-	-
25-34	.555***	.557***	.636***	.501***	.574***	.593***	.612***
	(.055)	(.055)	(.065)	(.059)	(.058)	(.072)	(.074)
35-44	.981	.941	1.072	.993	1.004	1.053	1.103
	(.092)	(.088)	(.106)	(.110)	(.096)	(.123)	(.131)
45-54	1.882***	1.733***	2.272***	1.953***	1.931***	2.221***	2.270***
	(.179)	(.167)	(.224)	(.219)	(.187)	(.262)	(.273)
55-64	2.511***	2.283***	3.939***	2.601***	2.615***	3.859***	3.879***
	(.240)	(.221)	(.402)	(.293)	(.253)	(.470)	(.486)
65-74	3.397***	3.103***	6.288***	3.850***	3.551***	6.699***	6.538***
	(.340)	(.315)	(.700)	(.453)	(.360)	(.864)	(.875)
75+	9.418***	8.504***	18.886***	10.925***	9.860***	19.884***	18.155***
	(1.146)	(1.052)	(2.481)	(1.530)	(1.214)	(2.996)	(2.857)
Gender							
Male	-	-	-	-	-	-	-
Female	1.128**	1.138**	1.125*	1.139**	1.139**	1.153**	1.044
	(.051)	(.052)	(.052)	(.056)	(.052)	(.058)	(.055)
Education							
LT Year 12	-	-	-	-	-	-	-
Year 12	1.437***	1.435***	1.382***	1.352***	1.361***	1.294**	1.296**
	(.120)	(.120)	(.116)	(.123)	(.115)	(.120)	(.122)
Dip/Cert	1.138*	1.129†	1.138*	1.042	1.100	1.020	1.021
	(.073)	(.072)	(.074)	(.073)	(.071)	(.073)	(.074)
Bachelor's +	1.119†	1.117†	1.113	1.046	.971	.945	.927
	(.074)	(.075)	(.075)	(.078)	(.067)	(.074)	(.074)
Indigenous status							
Not Indigenous	-	-	-	-	-	-	-
Indigenous	.422***	.415***	.424***	.455***	.486***	.494***	.511***
	(.070)	(.069)	(.071)	(.081)	(.083)	(.090)	(.094)
Language spoken at home							
Other language	-	-	-	-	-	-	-
English	-	.640***	-	-	-	.657**	.724*
		(.081)				(.094)	(.107)
Spoken English proficiency							
Not at all	-	.589	-	-	-	.245**	.242**
		(.307)				(.118)	(.118)
Not well	-	.771	-	-	-	.765	.793
		(.138)				(.153)	(.160)
Well	-	-	-	-	-	-	-
V well/mainly Eng	-	1.247	-	-	-	1.337†	1.394†
		(.191)				(.230)	(.243)
Year arrived							
Born in Australia	-	-	-	-	-	-	-
Before 2006	-	1.124†	-	-	-	1.068	1.050
		(.069)				(.072)	(.072)

more than 1 year ago, the modal level of lifetime risk is last consumed alcohol more than 1 week ago. For adults have never consumed alcohol, the modal level of lifetime risk is never having consumed alcohol.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
2006-2015	-	.707***	-	-	-	.769**	.735**
		(.065)				(.078)	(.076)
2016-18	-	.176***	-	-	-	.170***	.160***
		(.041)				(.047)	(.045)
Household type							
Family w. kids	-	-	-	-	-	-	-
Couple only	-	-	.537***	-	-	.543***	.544***
			(.035)			(.040)	(.041)
One-person	-	-	.317***	-	-	.330***	.336***
			(.021)			(.024)	(.025)
Other	-	-	1.064	-	-	1.090	1.117
			(.075)			(.092)	(.095)
Household income							
1st quartile	-	-	-	-	-	-	-
2nd quartile	-	-	-	1.206*	-	1.035	1.032
				(.097)		(.085)	(.085)
3rd quartile	-	-	-	1.587***	-	1.332***	1.388***
				(.130)		(.114)	(.119)
4th quartile	-	-	-	1.531***	-	1.295**	1.362***
				(.125)		(.113)	(.120)
5th quartile	-	-	-	1.362***	-	1.188†	1.304**
				(.113)		(.109)	(.120)
State/territory × GCCSA							
Sydney	-	-	-	-	-	-	-
Rest of NSW	-	-	-	-	.916	1.003	.974
					(.097)	(.108)	(.104)
Melbourne	-	-	-	-	1.134	1.164†	1.160†
					(.092)	(.105)	(.104)
Rest of VIC	-	-	-	-	.763*	.844	.813
					(.100)	(.109)	(.104)
Brisbane	-	-	-	-	.798**	.864	.860
					(.068)	(.083)	(.082)
Rest of QLD	-	-	-	-	.627***	.722***	.700***
					(.060)	(.069)	(.066)
SA	-	-	-	-	.757***	.837†	.812*
					(.066)	(.079)	(.076)
WA	-	-	-	-	.854†	.928	.924
					(.073)	(.087)	(.087)
TAS	-	-	-	-	.698***	.766**	.741**
					(.076)	(.073)	(.071)
NT	-	-	-	-	.365***	.356***	.356***
					(.048)	(.039)	(.039)
ACT	-	-	-	-	.714***	.746**	.769*
					(.066)	(.077)	(.080)
Remoteness							
Major cities	-	-	-	-	-	-	-
Inner regional	-	-	-	-	1.143†	-	-
					(.090)		
Outer regional	-	-	-	-	.887	-	-
					(.083)		
Remote	-	-	-	-	1.210	-	-
					(.209)		
SEIFA							
1st quintile	-	-	-	-	-	-	-
2nd quintile	-	-	-	-	1.091	1.027	-
					(.080)	(.081)	
3rd quintile	-	-	-	-	1.119	1.051	-
					(.083)	(.085)	

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
4th quintile	-	-	-	-	1.263**	1.156†	-
					(.095)	(.096)	
5th quintile	-	-	-	-	1.529***	1.286**	-
					(.124)	(.118)	
Smoking status							
Smoker	-	-	-	-	-	-	-
Ex-smoker	-	-	-	-	-	-	1.249**
							(.102)
Never smoked							1.323***
							(.107)
Alcohol lifetime risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	1.168*
							(.089)
Last drank 1+/wk	-	-	-	-	-	-	1.147
							(.104)
Never consumed	-	-	-	-	-	-	1.535***
							(.171)
Alcohol short term risk guidelines							
Exceeded	-	-	-	-	-	-	-
Did not exceed	-	-	-	-	-	-	1.325***
							(.089)
Last drank 12/mo	-	-	-	-	-	-	1.140
							(.129)
Never consumed	-	-	-	-	-	-	-
Intercept	.758	1.007†	.812	.567***	.730**	.849	.515**
	(.074)	(.154)	(.089)	(.071)	(.089)	(.168)	(.110)
F	102.760	65.996	93.599	71.137	50.240	36.951	34.759
Model DF	11	18	14	15	28	39	42
p	.000	.000	.000	.000	.000	.000	.000
n	15,769	15,764	15,769	13,652	15,769	13,648	13,439

† $p \leq .1$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

10. Discussion

There are extensive variations in telephone status by geography, demographics, health status and household characteristics. This has important implications with regard to equitable access to telecommunications across society and for the practice of survey research, which we discuss below. Our discussion begins with implications for telephone surveys, canvasses alternative sampling frames and, finally, addresses the special circumstances facing the Northern Territory in light of the high number of non-telephone households and limited landline coverage.

10.1. Implications for telephone surveys

10.1.1. Random digit dialling

Single frame landline RDD

Telephone surveys that use only landline random digit dialling (RDD) cannot provide unbiased estimates of the Australian population: the proportion of the Australian population who are not covered by the landline frame is too large and too distinct. Examples of landline-only RDD surveys include some single seat election polls using 'robocalls' (i.e., interactive voice response) in the place of interviewers.

Single frame mobile RDD

By contrast, single frame mobile RDD is viable, at least for national-level studies. Australia's largest RDD study, the National Visitor Survey, has recently moved to a mobile-only sampling approach. Unless estimates for persons aged 75 and above are important, coverage error is sufficiently small as to be ignorable. Moreover, there are compelling advantages for shifting to a single mobile phone frame. The creation of weights is simplified and the reduction in sample efficiency due to the frame compositing procedures needed for dual-frame surveys is entirely avoided, yielding a higher effective sample size for a fixed nominal sample size.

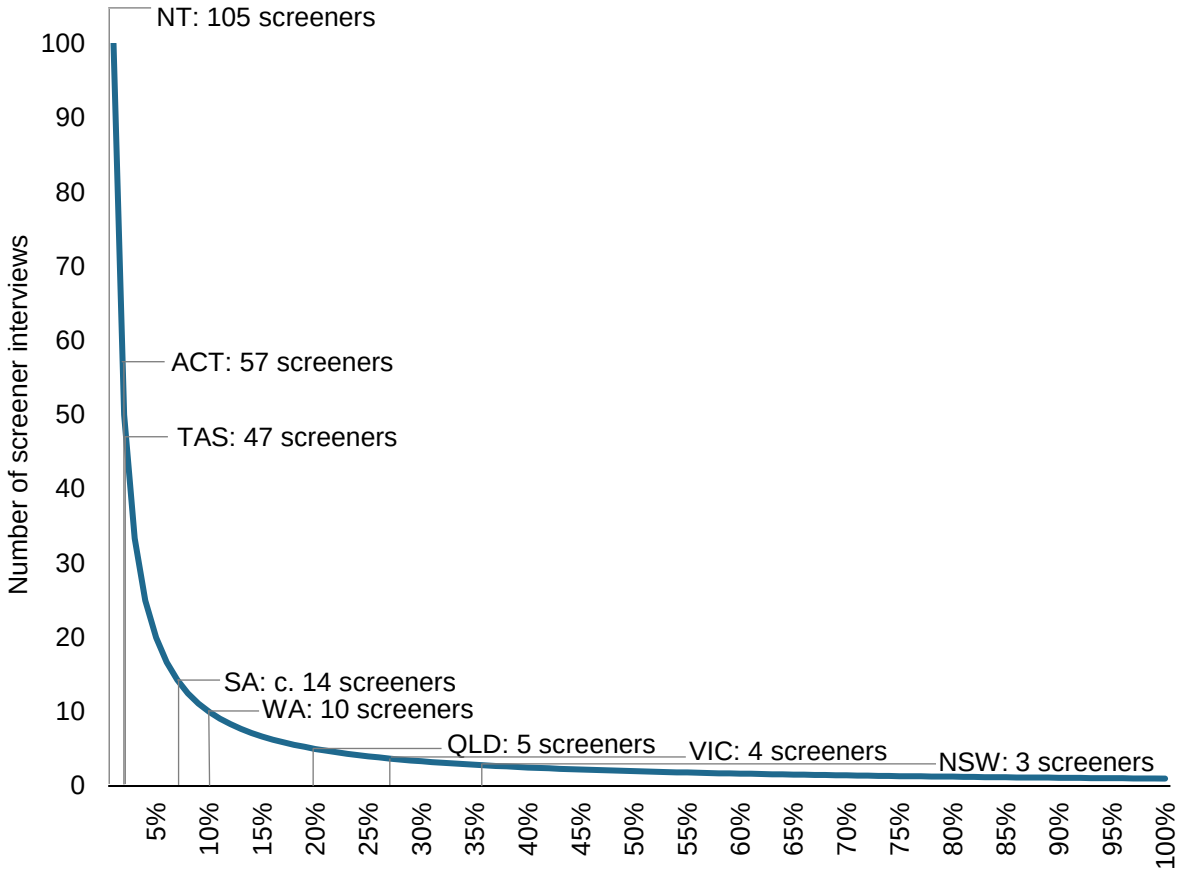
Sub-national telephone surveys

Sub-national telephone surveys in Australia face major challenges. At present, only the landline frame has geography attached to it, but this frame is unrepresentative of the population and growing less representative with each passing year. Finding mobile phone numbers in the right geography requires screener interviews, which adds considerable cost. (We discuss recently promulgated regulations that provide access to post codes for unlisted mobile numbers for certain kinds of research below.) As can be seen in Figure 23, the number of screener interviews required to interview one eligible respondent increases rapidly as the share of the population declines. Each screener interview has significant costs, and these are increasing as the productivity of telephone interviewing declines. Solutions to this problem have included using listed mobile sample in addition to or in place of mobile RDD and using pre-screened RDD sample.[22] These approaches all have drawbacks. Using listed sample to supplement mobile RDD reduces sampling efficiency (i.e., margins of error will be wider for a given sample size) and complicates weighting. Using listed mobile sample in place of mobile RDD is subject

[22] Listed sample in this context is a different from White Pages sample. Commercial vendors acquire names and contact information from sources such as credit reporting agencies, although the sources of listed sample are invariably treated by vendors as proprietary and not detailed to clients. Pre-screened RDD sample refers to RDD sample that screened out of a previous sub-national survey because it was in the wrong area. Respondents who screen out are asked to consent to be recontacted. Those who consent may then be recontacted for another survey.

to an unknown degree of coverage error due to the fact that the listed sample does not cover all mobile users. Pre-screened mobile RDD sample is likely subject to non-response error arising from people who do not agree to be recontacted, which may no longer be accurate at the time of recontact if some time has elapsed since the initial screening and the respondent has moved or the number has been reassigned to a different person.

Figure 23 Screener interviews required per eligible respondent by population incidence



Integrated Public Number Database

In a recent development, researchers can apply to the ACMA to access unlisted mobile phone numbers and related postcodes from the Integrated Public Number Database (IPND) (ACMA 2019b; *Telecommunications Regulations 2001* (Cth) r 1.7A, 5.2) if 'one or more of the following apply: (a) the research is relevant to public health, including epidemiological research; (b) the research relates to an electoral matter and conducted by or for: (i) a registered political party; or (ii) a political representative; or (iii) a candidate in an election for an Australian Parliament or a local government authority; (c) the research will contribute to the development of public policy and is conducted by or for the Commonwealth or a Commonwealth entity' (*Telecommunications Regulations 2001* (Cth) r 1.7A(1)) and the research is not conducted for a 'primarily commercial purpose' (*Telecommunications Regulations 2001* (Cth) r 1.7A(2)). As of the time of writing, details on access arrangements, the cost of access and the quality of the postcodes are not entirely clear and we look forward to obtaining further information.

Given that sub-national surveys are of particular importance to state and territory governments, we respectfully suggest that the limitation to public policy research by and for the Commonwealth or a Commonwealth entity is unduly restrictive and should be broadened to allow for research that will

contribute to the development of public policy and is conducted by or for a state and territory government or a state or territory government entity.

10.1.2. White Pages

White Pages samples do not provide representative samples of Australians. A large fraction (40.6%) of Australian adults only have a mobile phone; only 3.2% of these mobile-only adults report that their number is listed (ABS 2019a). White Pages samples will under-represent younger adults, smokers, people with high levels of psychological distress and recent migrants amongst many other important populations.

10.2. Alternative sampling frames

Given the need for mobile RDD in order to provide adequate coverage for telephone surveys, the high cost of sub-national RDD surveys and the declining productivity of telephone surveys, alternatives to RDD telephone surveys are a necessity. The U.S. market provides an instructive comparison.[23] Two major trends in the U.S. are the shift from telephone surveys using RDD samples to mixed-mode surveys using address-based samples and the continued growth of probability-based online panels. We have also observed the increased use of sample from non-probability online panels and address this below.

10.2.1. Address-based sampling

Address-based sampling (Battaglia et al. 2016; Iannacchione 2011; Link et al. 2008; Montaquila et al. 2013) has become the primary sampling frame for high quality surveys conducted for government, academic and non-profit clients in the U.S. (DeMatteis 2019), particularly as the telephone response rate has declined.[24] Typical designs allow responses in web and paper mode (DeMatteis 2019; Dillman 2017, 2019; Medway & Fulton 2012; Messer & Dillman 2011; Millar & Dillman 2011; Smyth et al. 2010). Calls can be made to households to which a telephone number can be matched in order to encourage survey response (DeMatteis 2019). Address-based sampling holds similar promise in Australia. The Social Research Centre has conducted a number of address-based sample surveys, including the Australian Election Survey 2016 and 2019, the Asian Barometer Survey 2018 and the World Values Survey 2018. These surveys have achieved higher response rates than would be possible for a telephone survey. Address-based samples are particularly attractive for surveys of small areas because of their ability to target precise geographies. An important limitation of address-based sampling is the extended time in field necessitated by working addresses by mail.

10.2.2. Probability-based online samples

Probability-based online panels are increasingly used as an alternative to telephone surveys. Although the U.S. has the greatest number of probability-based panels, they are in widespread use in many countries (Kaczmirek et al. 2019). Probability-based online panels recruit panellists from a sampling frame with good coverage properties and known probabilities of selection, typically address-based sampling, area-probability sampling, RDD or population registries. The offline population may be accommodated using a variety of methods, including mail, telephone or provision of an internet-

[23] Many European countries maintain population registries that enable surveys to directly target individuals rather than relying on indirect sampling frames such as addresses and telephone numbers. Also, European countries tend to be much more compact and densely settled, leading to much greater use of face-to-face interviewing. For these reasons, the U.S. and Canada are the most comparable developed countries to Australia.
[24] Response rates for U.S. telephone surveys are around 6% (Kennedy and Hartig 2019).

connected device. The Social Research Centre maintains Australia's only probability-based online panel, Life in Australia™.

10.2.3. Non-probability online samples

Online spending is estimated to amount to 44% of the $843 million in market and social research spending in Australia (ESOMAR 2017; RICA 2016). The vast majority of this spending is likely to be on non-probability online samples. These are convenience samples; claims of 'representativeness' refer to the use of quota sampling or similar procedures to match demographic distributions of the population (Callegaro et al. 2014a:11-12). Non-probability panels recruit members via online advertisements, email invitations, search engine advertising, co-registration agreements,[25] affiliate hubs,[26] snowball samples (member referral) and direct sign-up from the panel's own webpage (Baker et al. 2010 and Callegaro et al. 2014a). River sampling is another source of sample: advertisements placed online direct the people who click on the advertisement to an open survey (Baker et al. 2010:725; Callegaro et al. 2014a:5-6). There has been extensive research on the accuracy of non-probability samples compared to probability samples, with non-probability samples almost invariably performing worse than probability samples compared to external benchmarks (Callegaro et al. 2014b; Chang & Krosnick 2009; Dutwin and Buskirk 2017; Erens et al. 2014; Kaczmirek et al. 2019; Kennedy et al. 2016; MacInnis et al. 2018; Pennay et al. 2018; Yeager et al. 2011). Non-probability samples are also subject to types of errors not faced by probability surveys, such as fraudulent respondents and surveys completed by non-humans (bots) (Baker et al. 2014; Fahimi, Barlas & Thomas 2018). Non-probability samples also fail to cover the offline population, which may or may not be a problem depending on the population and topic under study. Simple weighting of non-probability samples has no effect or slightly increases error (Pennay et al. 2018; Riillo 2018; Yeager et al. 2011). Advanced methods for calibrating data from non-probability samples (DiSogra et al. 2011; Elliot & Valliant 2017; Fahimi et al. 2015, 2018; Lee 2006; Lee & Valliant 2009; Valliant & Dever 2011) appear to be able to reduce the excess error over probability samples by about 50% (Pennay et al. 2018; Yeager et al. 2011). Despite the better part of a decade having elapsed since its publication, the conclusion of Baker et al. (2010:758) that 'researchers should avoid nonprobability online panels when one of the research objectives is to accurately estimate population values' remains true today. However, as Baker et al. (2010:758) also note, there are times when a non-probability panel may be an appropriate choice, such as understanding correlations between variables.

10.3. Implications for the Northern Territory

One of the key findings of this analysis is that under-coverage from non-telephone households is a serious source of potential bias for surveys conducted in the Northern Territory.[27] Unfortunately, given the high costs of face-to-face surveying in the best of circumstances—and the great increases in cost for face-to-face interviewing exerted by the Territory's sparse and widely spread population—improving coverage for official statistics in the Northern Territory will be a costly endeavour that would require creative solutions (such as omnibus face-to-face surveys) to provide information on topics that would ordinarily be covered by stand-alone surveys.

[25] Co-registration agreements use email databases created by websites which register visitors and offer the opportunity to join other partner company databases (Baker et al. 2010:720).
[26] Sites offering access to various online merchants offering points for making purchases from participating merchants that can be redeemed for merchandise, with surveys and panels sometimes being posted alongside e-commerce sites (Baker et al. 2010:721).
[27] As very remote areas were excluded from the NHS, under-coverage will likely be under-estimated; 19.9% of the NT population lives in very remote areas (ABS 2017).

11. Conclusion

This report analyses Australian telephone access using data from the National Health Survey (NHS) 2017-18, fielded by the Australian Bureau of Statistics (2019a). The NHS is a multi-stage cluster probability sample with all interviewing conducted using face-to-face mode and, consequently, can provide valid estimates of telephone use, including for non-telephone households. The NHS also benefits from a large sample size (21,315 individuals in 16,384 households), allowing for detailed analysis of sub-populations.

Understanding the factors associated with telephone access is of interest in its own right and of critical importance to understanding the potential implications for the coverage error of telephone surveys. Telephone surveys are an important source of information for Australia and have important applications – including state-level population health surveys, state-level surveys of gambling, state-level recreational fishing surveys that provide information on fishing catch by species and are used in fisheries management, the National Visitor Survey, which continuously tracks domestic tourism and tourism spending and forms part of the Tourism Satellite Account in the Australian system of national accounts, the AusPlay survey, which continuously tracks Australian participation in sport and physical activity, the National Survey of Community Satisfaction with Policing which tracks satisfaction with policing services and feelings of public safety, political polls and other public opinion surveys.

The findings from NHS 2017-18 are comparable with similar estimates from the ACMA (2019a) Communications Report 2017-18, the other authoritative source of data on telephone status in Australia. Overall, 2.0% of adults are estimated to have no telephone service, 52.8% of adults are dual-users (they have a personal mobile phone and live in a household with landline service), 40.6% of adults are mobile-only (they have a personal mobile phone and live in a household without landline service) and 4.6% of adults are landline-only (they do not have a personal mobile phone and live in a household with landline service). As landline service has declined, the coverage of the White Pages has also diminished. Only 31.2% of adults were listed and another 9.3% were of unknown status.

There are meaningful variations in telephone service by geography. With respect to state/territory, the Northern Territory is noteworthy for the large proportion of adults without telephone service (7.0%) and the very limited number of landline telephones (only 32.1% of NT adults lived in landline households). There were also strong associations between area-level socio-economic status and telephone use. In areas with higher socio-economic status, dual-users were more common while areas with lower socio-economic status had higher proportions of mobile-only, landline-only and no phone households.

Turning to demographics, age is perhaps the most powerful predictor of phone status, with mobile access being near universal through to age 64 and declining thereafter, and landline access declining precipitously among younger age cohorts. Education is also strongly associated with telephone status, although these differences attenuate when other factors are controlled for. Adults with higher education are more likely to be mobile-only, while adults with less than Year 12 education are particularly likely to be landline-only. Indigenous status is also strongly associated with phone use, with Indigenous adults being far more likely to be mobile-only and far less likely to be dual-users than non-Indigenous adults. Variables associated with migration are also associated with telephone use. Adults who migrated to Australia before 2006 are far less likely than those born in Australia (or who migrated more recently) to be mobile-only and are more likely to be dual-users or landline-only, although the difference between earlier migrants and adults born in Australia ceases when other variables are controlled for. Adults who speak English well or very well (but do not mainly speak English) are the most likely to be mobile-only and the least likely to be dual-users. Adults who speak English not well or not at all are the least likely to be mobile-only or dual-users and the most likely to

be landline-only. The relationship between speaking a language other than English at home and phone status changes markedly when other variables are controlled for. With a simple bivariate tabulation, adults who speak a language other than English at home are somewhat more likely to be mobile-only and less likely to be dual-users. After other variables are controlled for, adults who speak a language other than English at home have lower odds of being mobile-only and higher odds of being dual-users. Employed adults are more likely to be mobile-only and less likely to be dual-users or landline-only than those who are unemployed or not in the labour force, although these effects dissipate almost entirely when other variables are controlled for.

Of household-level variables, family composition and household income are predictors of telephone status. One-person households are particularly likely to be mobile-only while families with children are more likely to be dual-users; couple only family households occupy an intermediate place. Higher levels of household income are associated with greater likelihood of being a dual-user. Tenure type is very strongly tied to telephone usage at the bivariate level, with renters being particularly likely to be mobile-only and homeowners without mortgages having the highest levels of being dual-users or landline-only. The effect of tenure, however, ceases entirely when other variables are controlled for.

As a health survey, NHS also contains a wealth of variables measuring health conditions and risk factors. All the conditions and risk factors that we examined were associated with telephone status in some fashion: body-mass index, fruit and vegetable consumption, hypertension, physical activity, smoking, alcohol use, disability status, psychological distress and self-assessed health. Even after controls for other variables, smokers are more likely to be mobile-only than either ex-smokers or those who never smoked, as are those who exceed either lifetime or short-term alcohol risk guidelines. Disability status also remains significant as a predictor of telephone status when other variables are controlled for, although the effect was small and the effects by severity of disability are variable.

Based on our review, we believe that surveys that rely solely on landline numbers are not viable due to the manifest coverage error both in terms of under-coverage in general and differential under-coverage of specific groups (such as younger adults, non-English speakers, recent migrants, one-person households and current smokers). White Pages samples are prone to even larger coverage error with—at best—40.5% of the adult population being accessible via a directory listed number (31.2% know they are listed, 9.3% unknown listing status).

In contrast, single frame mobile random digit dialling (RDD) has little in the way of coverage error due to the small fraction of landline-only adults. For national surveys, we see dual-frame RDD as a necessity only if estimates of adults age 75 and above are important to the research question being asked.

Because Australian mobile numbers are not associated with geography, the declining coverage of the landline frame leaves sub-national telephone surveys stuck between high cost due to the need for large-scale screening if mobile RDD sample is employed, and high coverage error if RDD mobile sample is not used. Recent changes to regulations covering the Integrated Public Number Database (IPND) open up new possibilities for health surveys, but the picture remains quite bleak for other telephone surveys. As such, we recommend giving access to post code information for unlisted mobile numbers on the IPND for surveys that contribute to the development of public policy and are conducted by or on behalf of state or territory governments. Where IPND access is not possible, address-based sampling offers an attractive alternative that combines the ability to accurately target small areas with higher response rates that can be achieved on telephone surveys. Probability-based online panels in the form of Life in Australia™, Australia's only such panel, offer another alternative to telephone surveys.

Finally, we draw attention to the implications of this paper for the Northern Territory. The NT has an exceptionally high proportion of its adult population in non-telephone households (7.0%)—and even this estimate is, in all likelihood, too low because the NHS excludes very remote areas that hold 19.9% of the NT population. If that were not enough of a handicap, the fact that the NT has the lowest landline coverage *and* less than 1% incidence in the mobile frame means that it is virtually impossible to obtain representative telephone samples at remotely affordable cost. In our view, these factors suggest that special measures are required to provide high quality data on the NT population that can be used in the formulation of government policy, such as omnibus household surveys to collect data for official statistics that would ordinarily be covered by separate data collection efforts.

List of abbreviations and terms

AAPOR	American Association for Public Opinion Research
ABS	Australian Bureau of Statistics
ACMA	Australian Communications and Media Authority
BFU	Base Frame Unit
DFRDD	Dual-frame random digit dialling
FSU	First Stage Unit
IPND	Integrated Public Number Database
NHMRC	National Health and Medical Research Council
NHS	National Health Survey
RDD	Random digit dialling
SEIFA	Socio-Economic Indexes for Areas
SIH	Survey of Income and Housing

Appendix A Australian Telephone Surveys

Sponsor	Survey	Frames	Details
ACT Gambling and Racing Commission	ACT Gambling and Prevalence Survey	Landline random digit dialling (RDD) Listed mobile sample	Run every five years with 7,500 interviews (2019) providing data on the social and economic impacts of gambling in the ACT
ACT Government	ACT General Health Survey	Landline RDD Pre-screened mobile RDD Listed mobile sample	Annual survey with 1,200 adult interviews
Austrade	National Visitor Survey	Mobile RDD	Permanent tracking survey with 120,000 interviews per year providing data on tourism spending for the Tourism Satellite Account and other information for stakeholders
Australian and New Zealand Policing Advisory Agency	National Survey of Community Satisfaction with Policing	Dual-frame listed sample	Annual survey with c. 14,000 interviews providing data on levels of satisfaction with policing services and feelings of public safety
Australian Federal Police (AFP)	Community Confidence Survey	Not stated	1,000 completed interviews (2018) providing data on community confidence in the AFP's contribution to law enforcement and national security
Australian Government Department of Home Affairs	Continuous Survey of Australian Migrants	Listed sample from migrant applications	Multiple mode survey with telephone component providing data on new migrants
Cancer Institute NSW	NSW Smoking & Health Survey	DFRDD	Periodic survey with 3,150 completed interviews (2017) providing data on smokers' use of tobacco and knowledge and attitudes
Fisheries Victoria	South Australian Recreational Fishing Survey	Landline RDD (2013-14) Listed mobile sample (2013-14) Boat ramp and beach intercept	Periodic survey with 2,782 screened households (2013-14) providing data on fishing catch and effort

Sponsor	Survey	Frames	Details
Ipsos	Political polling	DFRDD	Periodic poll providing information on party preference and preferred prime minister
NT Department of Primary Industry and Resources	NT Recreational Fishing Survey	Directory sample from paper White Pages (2009-10) Boat ramp intercept	Periodic survey screening 2,596 households (2009-10) providing data on fishing catch and effort
NT Government	NT Gambling, Health and Wellbeing Survey	Landline RDD Listed mobile sample	Periodic surveys with 5,000 interviews (2018) providing data on gambling participation, problem gambling and health and social and emotional wellbeing indicators
NSW Department of Primary Industries	Survey of Recreational Fishing in NSW and the ACT	Directory sample from paper White Pages (2013-14)	Periodic surveys with c. 9,500 households screened (2013-14)
NSW Ministry of Health	NSW Public Health Survey	DFRDD	Annual survey with c. 15,000 interviews providing ongoing information on health behaviours, health status and other factors that influence the health of people in NSW
Queensland Department of Agriculture and Fisheries	Queensland Recreational Fishing Survey	DFRDD (2018-19) Listed mobile sample (2018-19)	Periodic survey designed to have 2,000 screened households (2018-19) providing data on fishing catch and effort
Queensland Health	Queensland preventative health surveys	Listed dual-frame sample	Annual surveys with 12,500 adults and 2,500 parents of children aged 5 to 17 providing information on preventative health indicators
SA Department of Human Services	SA Gambling Prevalence Survey	Landline RDD Listed mobile sample	Periodic survey with c. 20,000 interviews (2018) providing data on the nature and prevalence of gambling activities of South Australians
SA Health	SA Population Health Survey	DFRDD	Monthly survey with c. 7,000 interviews per year providing data on the health and wellbeing of South Australians

Sponsor	Survey	Frames	Details
Sport Australia	AusPlay	DFRDD	Permanent tracking survey with c. 20,000 adult and 3,600 child interviews per year providing data on sport and physical activity participation
Tasmanian Department of Health and Human Services	Tasmanian Population Health Survey	Landline RDD Pre-screened mobile RDD Listed mobile sample	Triennial survey with 6,300 interviews (2016) providing information on health conditions and risk factors of Tasmanians
Tasmanian Government	Survey of Recreational Fishing in Tasmania	White Pages	Periodic survey screening 3,290 households (2012-13) providing data on fishing catch and effort
Victorian Department of Education and Training	Victorian Child Health and Wellbeing Survey	Pre-screened mobile RDD Listed mobile sample	Periodic survey of parents and carers of Victorian children under 13 designed to address data gaps identified under the Child and Adolescent Health Outcomes Framework
Victorian Department of Health and Human Services	Victorian Public Health Survey	DFRDD Listed mobile sample	Annual survey with 7,100 interviews (2018) providing information on health conditions and risk factors of Victorians
WA Department of Health	WA Health and Wellbeing Surveillance System	White Pages	Monthly surveys with c. 9,700 interviews per year providing information on indicators of health and wellbeing
WA Department of Primary Industries and Regional Development	Statewide survey of boat-based recreational fishing in WA	Listed sample (fishing license holders)	Periodic survey with 4,388 screened households (2016-17) providing data on fishing catch and effort
YouGov and *The Australian*	Newspoll	Landline RDD (interactive voice response) Non-probability web panel	Periodic (generally monthly) poll providing widely consumed information on party preference and preferred prime minister

Appendix B NHS 2017-18 Telephone Questions

Questions used to derive telephone status from the 20171-8 National Health Survey.

* Ask all
PHONE_Q01 [Do you/Does [first name]] have a fixed or landline telephone connected to this dwelling?

1	Yes	Ask PHONE_Q02
5	No	Skip to PHONE_Q03
6	Don't know	Skip to PHONE_Q03

* Ask if PHONE_Q01 = 1
PHONE_Q02 Is [your/his/her] landline number listed in the white pages?

1	Yes	Ask PHONE_Q03
5	No	Ask PHONE_Q03
6	Don't know	Ask PHONE_Q03

* Ask if PHONE_Q01 = 5 or 6 or PHONE_Q02 = ALL
PHONE_Q03 [Do you/Does [first name]] have a mobile phone?

Include smart phones

1	Yes	Ask PHONE_SG01
5	No	Ask PHONE_SG01
6	Don't know	Ask PHONE_SG01

* Ask if PHONE_Q03 = ALL
PHONE_SG01 <No question asked. Used for routing only.>

1	IF the selected adult has a mobile phone	Skip to PHONE_Q05
2	ELSEIF there is more than 1 person aged 15+ in the household	Ask PHONE_Q04
3	Otherwise	End module

* Ask if PHONE_SG01 = 2
PHONE_Q04 Does anyone else in this dwelling have a mobile phone?

Include smart phones

1	Yes	Ask PHONE_Q05
5	No	End module
6	Don't know	End module

* Ask if PHONE_SG01 = 1 or PHONE_Q04 = 1
PHONE_Q05 [Is that mobile number/Are any of these mobile numbers] listed in the white pages?

1	Yes	End module
5	No	End module
6	Don't know	End module

Appendix C NHS 2017-18 Methodology

The NHS is conducted every three years. Although it is primarily intended to provide estimates of the prevalence of long-term health conditions, health risk factors such as smoking, obesity, alcohol consumption and physical activity and demographic and socio-economic characteristics, the ABS included questions on telephone access. In this section, we describe the key methodological characteristics of the NHS. Unless otherwise specified, all information comes from ABS (2018a).

In keeping with its role of providing official statistics on the health of the Australian population, the NHS is a high-quality survey with an admirable response rate. It is fielded solely via in-person interviewing, providing a very sound basis for estimates of the telephone status of Australians. NHS data is not collected by phone. The primary limitations of the NHS are those of coverage. Very remote areas were not surveyed, nor were discrete Aboriginal and Torres Strait Islander communities. These exclusions are likely to slightly overstate telephone access and under-estimate the portion of the population without a telephone service. The survey is also limited to private residences and excludes group quarters.

Field methods

Data collection is by in-person interview. One adult aged 18 or above is interviewed per household, being asked questions about their own characteristics and about the household. Data are also collected from and about children, but these are not analysed in this paper.

Sample

Sample size

A total of 21,315 individuals residing in 16,384 households were interviewed.

Target population

The target population of the NHS consists of residents in private dwellings in all states and territories. Non-private dwellings such as hotels, motels, hospitals, nursing homes and short-stay caravan parks are excluded from the survey. Australian External Territories are not included. Very Remote Areas and discrete Aboriginal and Torres Strait Islander communities are excluded. Very Remote Areas account for 0.7% of dwellings and 0.8% of both families and adults aged 18+ (ABS 2017). The NHS sample excludes certain diplomatic personnel of overseas governments, who are customarily excluded from the Census and the estimated residential population, and members of non-Australian defence forces and their dependents who are stationed in Australia.

Sampling frame

A multi-stage area probability sample was used (Radisich 2019). First stage units (FSU) are selected from across Australia. These units are similar in size to Statistical Area Level 1; there are about 55,000 FSU (Radisich 2019). The second stage of selection takes place within FSUs. Base frame units (BFU) based on mesh blocks are selected within the FSU. A BFU consists of around 40 dwellings. Cluster size within BFU varies between 5 and 15 depending on area size; urban areas have smaller cluster sizes and rural and remote areas have larger cluster size. Achieved cluster size may be smaller due to non-response. In some clusters, sampled dwellings are split between the NHS and the Survey of Income and Housing (SIH), which is integrated with the NHS.

Respondent selection

The respondent is selected by random draw from the household roster by the computer-assisted personal interviewing software (Radisich 2019).

Response rate

The household level response rate is 76.1%.[28]

Weighting

Base weights are calculated as the inverse of the probability of selection of the individual.[29] The weighted sample is then calibrated to the interaction of age (0-1, 2-4, 5-9, 10-11, 12-14, 15-17, 18-24, 25-34, 35-44, 45-54, 55-64, 65+) and sex within area of usual residence (Greater Capital City Statistical Area, except for Queensland where Statistical Area Level 4 was used), with cells collapsed in some instances to ensure that the weights are fit to purpose. In addition to these factors, the sample is also calibrated to remoteness. In addition, information from the combined NHS and SIH sample is used to increase the accuracy of estimates of smoker classification (current daily / not current daily) at the state by age group by sex level.

[28] This appears to be similar to American Association for Public Opinion Research (AAPOR) Response Rate 1.
[29] This section is informed by Radisich (2019).

References

Alexander M, Hayes L & Durkin S (2012). *Smoking prevalence and consumption in Victoria: key findings from the 1998-2011 population surveys*, Centre for Behavioural Research in Cancer, Cancer Control Research Institute, Cancer Council of Victoria, Melbourne.

AAPOR (American Association for Public Opinion Research) (2010). *New considerations for survey researchers when planning and conducting RDD telephone surveys in the U.S. with respondents reached via cell phone numbers*, AAPOR, Oakbrook Terrace, Illinois.

Australian Bureau of Statistics (ABS) (2012). *Information paper: use of the Kessler Psychological Distress Scale in ABS health surveys, Australia 2007-08*, cat. no. 4817.0.55.001, ABS, Belconnen.

----- (2013). *Migrant data matrices, 2013*, cat. no. 3415.0, ABS, Belconnen.

----- (2016a). *Technical paper: Socio-Economic Indexes for Areas (SEIFA) 2016*, cat. no. 2033.0.55.001, ABS, Belconnen.

----- (2016b). *Census of Population and Housing: Census dictionary, 2016*, cat. no. 2901.0, ABS, Belconnen.

----- (2017). *Census of Population and Housing, 2016* [MRDF], ABS, Belconnen.

----- (2018a). *National Health Survey: first results, 2017-18*, cat. no. 4364.0.55.001, ABS, Belconnen.

----- (2018b). *Australian Statistical Geography Standard (ASGS): Volume 5 – remoteness structure, July 2016*, cat. no. 1270.0.55.005, ABS, Belconnen.

----- (2019a). *2017-18 National Health Survey 2017-18* [MRDF], ABS, Belconnen, ACT.

----- (2019b). *Survey of Income and Housing, user guide, Australia, 2017-18*, cat. no. 6553.0, ABS, Belconnen.

ACMA (Australian Communications and Media Authority) (2012). *Communications report 2011-12*, ACMA, Belconnen.

----- (2013). *Communications report 2012-13*, ACMA, Belconnen.

----- (2014). *Communications report 2013-14*, ACMA, Belconnen.

----- (2015). *Communications report 2014-15*, ACMA, Belconnen.

----- (2016). *Communications report 2015-16*, ACMA, Belconnen.

----- (2017). *Communications report 2016-17*, ACMA, Belconnen.

----- (2019a). *Communications report 2017-18*, ACMA, Belconnen.

----- (2019b). *IPND access arrangements*, ACMA, Pyrmont, https://www.acma.gov.au/theACMA/ipnd-access-arrangements.

Australian Government Department of Health (2019). *Australia's physical activity and sedentary behaviour guidelines and the 24-hour movement guidelines*, Department of Health, Canberra, https://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines.

Badcock PB, Patrick K, Smith AMA, Simpson JM, Pennay D, Rissel CE, de Visser RO, Grulich AE & Richters J. 2017. Differences between landline and mobile phone users in sexual behavior research. *Archives of Sexual Behavior* 46:1711–1721.

Baffour B, Haynes M, Dinsdale S, Western M & Pennay D (2016). Profiling the mobile-only population in Australia: insights from the Australian National Health Survey. *Australia and New Zealand Journal of Public Health* 40(5):443–447.

——, Roselli T, Haynes M, Bon JJ, Western M & Clemens M (2017). Including mobile-only telephone users in a statewide preventative health survey—differences in the prevalence of health risk factors and impact on trends. *Preventative Medicine Reports* 7:91-98.

Baker R, Blumberg SJ, Brick JM, Couper MP, Courtright M, Dennis JM, Dillman D, Frankel MR, Garland P, Groves RM, Kennedy C, Krosnick J, Lavrakas PJ, Lee S, Link M, Piekarski L, Rao K, Thomas RK & Zahs D (2010). Research synthesis: AAPOR report on online panels. *Public Opinion Quarterly* 74(4):711–781.

——, Miller C, Kachhi D, Lange K, Wilding-Brown L & Tucker J (2014). Validating respondents' identity in online samples: the impact of efforts to eliminate fraudulent respondents. In: Callegaro M, Baker R, Bethlehem J, Göritz A, Krosnick J & Lavrakas PJ (eds.), *Online panel research: a data quality perspective*, Wiley, Hoboken, New Jersey, 441–456.

Barr ML, van Ritten JJ, Steel DG & Thackway SV (2012). Inclusion of mobile phone numbers into an ongoing population health survey in New South Wales, Australia: design, methods, call outcomes, costs and sample representativeness. *BMC Medical Research Methodology* 12:177.

Battaglia MP, Dillman DA, Frankel MR, Harter R, Buskirk TD, McPhee CB, DeMatteis JM & Yancey T (2016). Sampling, data collection, and weighting procedures for address-based sample surveys. *Journal of Survey Statistics and Methodology* 4(4):476–500.

Bernal RTI, Malta DC, Claro RM & Monteiro CA (2017). Effect of the inclusion of mobile phone interviews to Vigitel. *Revista de Saúde Pública* 51(S1):15s.

Best J (2010). First-stage weights for overlapping dual frame telephone survey, paper presented at the 65th annual conference of the American Association for Public Opinion Research, Chicago, Illinois, 15 May 2010.

Blumberg SJ & Luke JV (2007). *Wireless substitution: early release of estimates from the National Health Interview Survey, July–December 2006*, National Center for Health Statistics, Hyattsville, Maryland.

—— & Luke JV (2012). *Wireless substitution: early release of estimates from the National Health Interview Survey, July–December 2011*, National Center for Health Statistics, Hyattsville, Maryland.

—— & Luke JV (2015). *Wireless substitution: early release of estimates from the National Health Interview Survey, January–June 2015*, National Center for Health Statistics, Hyattsville, Maryland.

—— & Luke JV (2019). *Wireless substitution: early release of estimates from the National Health Interview Survey, July–December 2018*, National Center for Health Statistics, Hyattsville, Maryland.

Boyle JM, Lewis F & Tefft B (2010). Segmented or overlapping dual frame samples in telephone surveys. *Survey Practice* 3(6).

Brick JM, Brick PD, Dipko S, Presser S, Tucker C & Yuan Y (2007). Cell phone survey feasibility in the U.S.: sampling and calling cell numbers versus landline numbers. *Public Opinion Quarterly* 71(1):23–39.

——, Dipko S, Presser S, Tucker C & Yuan Y (2006). Nonresponse bias in a dual frame sample of cell and landline numbers. *Public Opinion Quarterly* 70(5):780–793.

——, Edwards WS & Lee S (2007). Sampling telephone numbers and adults, interview length, and weighting in the California Health Interview Survey cell phone pilot study. *Public Opinion Quarterly* 71(5):793–813.

——, Flores Cervantes I, Lee S & Norman G (2011). Nonsampling errors in dual frame telephone surveys. *Survey Methodology* 37(1):1–12.

Brunner JA & Brunner GA (1971). Are voluntarily unlisted telephone subscribers really different? *Journal of Marketing Research* 8(1):121–124.

Callegaro M, Ayhan O, Gabler S, Haeder S & Villar A (2011). *Combining landline and mobile phone samples: a dual frame approach*, GESIS Leibniz-Institut für Sozialwissenschaften, Mannheim, Germany.

——, Baker R, Bethlehem J, Göritz A, Krosnick J & Lavrakas PJ (2014a). Online panel research: history, concepts, applications and a look at the future. In: Callegaro M, Baker R, Bethlehem J, Göritz A, Krosnick J & Lavrakas PJ (eds.), *Online panel research: a data quality perspective*, Wiley, Hoboken, New Jersey, 1–22.

——, Steeh C, Buskirk TD, Vehovar V, Kuusela V & Piekarski L (2007). Fitting disposition codes to mobile phone surveys: experiences from studies in Finland, Slovenia and the USA. *Journal of the Royal Statistical Society, Series A* 170(3):647–670.

——, Villar A, Yeager D & Krosnick JA (2014b). A critical review of studies investigating the quality of data obtained with online panels based on probability and nonprobability samples. In: Callegaro M, Baker R, Bethlehem J, Göritz A, Krosnick J & Lavrakas PJ (eds.), *Online panel research: a data quality perspective*, Wiley, Hoboken, New Jersey, 23–53.

Chang L & Krosnick JA (2009). National surveys via RDD telephone interviewing versus the internet: comparing sample representativeness and response quality. *Public Opinion Quarterly* 73(4):641–678.

Commonwealth of Australia (2018). *Telecommunications Amendment (Access to Mobile Number Information for Authorised Research) Regulations 2018*.

Cooper SL (1964). Random sampling by telephone–an improved method. *Journal of Advertising Research* 1(4):45–48.

Dal Grande E & Taylor AW (2010). Sampling and coverage issues of telephone surveys used for collecting health information in Australia: results from a face-to-face survey from 1999 to 2008. *BMC Medical Research Methodology* 10:77.

——, Taylor E & Wilson D (2005). Is there a difference in health estimates between people with listed and unlisted telephone numbers? *Australian and New Zealand Journal of Public Health* 29(5):448–456.

DeMatteis JM (2019). Advances in address based sampling. Short course presented at the 74th annual conference of the American Association for Public Opinion Research, Toronto, 15 May 2019.

Dillman DA (2017). The promise and challenge of pushing respondents to the web in mixed-mode surveys. *Survey Methodology* 43(1):3–30.

—— (2019). The world-wide challenge of developing effective web-push survey methods. Short course presented at the 74th annual conference of the American Association for Public Opinion Research, Toronto, 16 May 2019.

DiSogra C, Cobb C, Chan E & Dennis JM (2011). Calibrating non-probability samples with probability samples using early adopter characteristics. *Proceedings of the Section on Survey Research Methods of the American Statistical Association*, 4501–4515.

Dutwin D & Buskirk TD (2017). Apples to oranges or gala versus golden delicious? Comparing data quality of nonprobability internet samples to low response rate probability samples. *Public Opinion Quarterly* 81(S):213–249.

——, Kennedy C, Keeter S & Kulp D (2008). *Dual frame (landline and cell RDD) estimation in a national survey of Latinos*, International Communications Research, Media, Pennsylvania.

Elliot MR & Valliant R (2017). Inference for non-probability samples. *Statistical Science* 31(1):249–264.

Erens B, Burkill S, Couper MP, Conrad F, Clifton S, Tanton C, Phelps A, Datta J, Mercer CH, Sonnenberg P, Prah P, Mitchell KR, Wellings K, Johnson AM & Copas AJ (2014). Nonprobability web surveys to measure sexual behaviors and attitudes in the general population: a comparison with a probability sample interview survey. *Journal of Medical Internet Research* 16(12):e276.

ESOMAR (2017). *Global market research 2017: an ESOMAR industry report*, ESOMAR, Amsterdam.

Fahimi M, Buttermore N, Thomas RK & Barlas FM (2015). Scientific surveys based on incomplete sampling frames and high rates of nonresponse. *Survey Practice* 8(6).

——, Barlas FM & Thomas RK (2018). The mixology of samples: blending probability and nonprobability samples. Webinar, American Association for Public Opinion Research, 13 March 2018.

Fletcher JE & Thompson HB (1974). Telephone directory samples and random telephone number generation. *Journal of Broadcasting* 18(2):187–192.

Frankel MR, Battaglia MP, Link M & Mokdad AH (2007). Integrating cell phone numbers into random digit-dialed (RDD) landline surveys. *Proceedings of the Section on Survey Research Methods of the American Statistical Association*, 3793–3800.

Glasser GJ & Metzger GD (1972). Random-digit dialing as a method of telephone sampling. *Journal of Marketing Research* 9(1):59–64.

—— & Metzger GD (1975). National estimates of nonlisted telephone households and their characteristics. *Journal of Marketing Research* 12(3):359–361.

Gruszin F & Szuster F (2010). *Audit of Australian chronic disease and associated risk factor data collections*, Public Health Information Development Unit, the University of Adelaide, Adelaide.

Guterbock TM, Lavrakas PJ, Tompson TN & ZuWallack R (2011). Cost and productivity ratios in dual-frame RDD telephone surveys. *Survey Practice* 4(2).

Holborn AT, Reavley NJ & Jorm AF (2012). Differences between landline and mobile-only respondents in a dual-frame mental health literacy survey. *Australian and New Zealand Journal of Public Health* 36(2):192–193.

Iannacchione VG (2011). Research synthesis: the changing role of address-based sampling in survey research. *Public Opinion Quarterly* 75(3):556–575.

Ivie K, Pels R, Zentrichova D & Herr D (2006). Cellular telephones in list-assisted, random digit dial sample. *Proceedings of the Section on Survey Research Methods of the American Statistical Association*, 4136–4140.

Jackson AC, Pennay D, Dowling NA, Coles-Janess B & Christensen DR (2014). Improving gambling survey research using dual-frame sampling of landline and mobile phone numbers. *Journal of Gambling Studies* 30:291–307.

Judd RC (1966). Telephone usage and survey research. *Journal of Advertising Research* 6(4):38–39.

Kaczmirek L, Phillips B, Pennay DW, Lavrakas PJ & Neiger D (2019). *Building a probability-based online panel: Life in Australia™*, CSRM & SRC Methods Paper No. 2/2019, Centre for Social Research & Methods, Research School of Social Sciences, College of Arts & Social Sciences, the Australian National University, Canberra.

Keeter S, Kennedy C, Clark A, Tompson T & Mokrzycki M (2007). What's missing from national landline RDD surveys? The impact of the growing cell-only population. *Public Opinion Quarterly* 71(5):772–792.

Kennedy C (2007). Evaluating the effects of screening for telephone service in dual frame RDD surveys. *Public Opinion Quarterly* 71(5):750–771.

—— & Hartig H (2019). *Response rates in telephone surveys have resumed their decline*, Pew Research Center, Washington, DC.

——, Mercer A, Keeter S, Hatley N, McGeeney K & Gimenez A (2016). *Evaluating online nonprobability surveys: vendor choice matters; widespread errors found for estimates based on blacks and Hispanics*, Pew Research Center, Washington, DC.

Kohut A, Keeter S, Doherty C & Dimock M (2008). Ways of coping with a growing segment: the impact of 'cell-onlys' on public opinion polling, Pew Research Center, Washington, DC.

Kuusela V, Callegaro M & Vehovar V (2008). The influence of mobile telephones on telephone surveys. In: Lepkowski JM, Tucker C, Brick JM, de Leeuw ED, Japec L, Lavrakas PJ, Link MW & Sangster RL (eds.), *Advances in telephone survey methodology*, Wiley, Hoboken, New Jersey, 87–112.

Lavrakas PJ, Shuttles CD, Steeh C & Fienberg H (2007). The state of surveying cell phone numbers in the United States: 2007 and beyond. *Public Opinion Quarterly* 71(5):840–854.

Lee S (2006). Propensity score adjustment as a weighting scheme for volunteer panel web surveys. *Journal of Official Statistics* 22(2):329–349.

—— & Valliant R (2009). Estimation for volunteer panel web surveys using propensity score adjustment and calibration adjustment. *Sociological Methods & Research* 37(3):319–343.

Leuthold DA & Scheele R (1971). Patterns of bias in samples based on telephone directories. *Public Opinion Quarterly* 35(2):249–257.

Link MW, Battaglia MP, Frankel MR, Osborn L & Mokdad AH (2007). Reaching the U.S. cell phone generation: comparison of cell phone survey results with an ongoing landline telephone survey. *Public Opinion Quarterly* 71(5):814–839.

——, Battaglia MP, Frankel MR, Osborn L & Mokdad AH (2008). A comparison of address-based sampling (ABS) and random-digit dialing (RDD) for general population surveys. *Public Opinion Quarterly* 72(1):6–27.

Livingston M, Dietze P, Ferris J, Pennay D, Hayes L & Lenton S (2013). Surveying alcohol and other drug use through telephone sampling: a comparison of landline and mobile phone samples. *BMC Medical Research Methodology* 13:41.

Liu B, Brotherton JML, Donovan B, Saville M & Kaldor JM (2011). Mobile phones are a viable option for surveying young Australian women: a comparison of two telephone methods. *BMC Medical Research Methodology* 11:159.

Lyle JM, Stark KE & Tracey SR (2014). *2012-13 survey of recreational fishing in Tasmania*, Institute for Marine & Antarctic Studies, University of Tasmania, Hobart.

MacInnis B, Krosnick JA, Ho AS & Cho MJ (2018). The accuracy of measurements with probability and nonprobability survey samples: replication and extension. *Public Opinion Quarterly* 82(4):707–744.

Massey JT (1988). An overview of telephone coverage. In: Groves RM, Biemer PP, Lyberg LE, Massey JT, Nicholls WL & Waksberg J (eds.), *Telephone survey methodology*, Wiley, Hoboken, New Jersey, 3–8.

Medway RL & Fulton J (2012). Where more gets you less: a meta-analysis of the effect of concurrent web options on mail survey response rates. *Public Opinion Quarterly* 76(4):733–746.

Messer BL & Dillman DA (2011). Surveying the general public over the internet using address-based sampling and mail contact procedures. *Public Opinion Quarterly* 75(3):429–457.

Millar MM & Dillman DA (2011). Improving response to web and mixed-mode questionnaires. *Public Opinion Quarterly* 75(2):249–269.

Montaquila JM, Brick JM, Williams D, Kim K & Han D (2013). A study of two-phase mail survey data collection methods. *Journal of Survey Statistics and Methodology* 1(1):66–87.

National Health and Medical Research Council (NHMRC) (2009). *Australian guidelines to reduce health risks from drinking alcohol*, NHMRC, Canberra.

Pennay A, Cheetham A, Droste N, Miller P, Lloyd B, Pennay D, Dowling N, Jackson A & Lubman DI (2015). An examination of the prevalence, consumer profiles, and patterns of energy drink use, with and without alcohol, in Australia. *Alcoholism: Clinical and Experimental Research* 39(8):1485-1492.

Pennay DW (2010). Profiling the 'mobile phone only' population: results from a dual-frame telephone survey, paper presented at the Social Science Methodology Conference 2010 of the Australian Consortium for Social and Political Research Inc., Sydney, 1 December 2010.

—— (2012). 'Mobile phone only' a source of non-ignorable bias. *Research News* 29(7):26–27.

—— D & Challice G (2006). A comparative analysis of EWP and RDD sample frames, paper presented at the Social Science Methodology Conference 2006 of the Australian Consortium for Social and Political Research Inc., Sydney, 11 December 2006.

——, Neiger D, Lavrakas PJ & Borg K (2018). *The online panels benchmarking study: a total survey error comparison of findings from probability-based surveys and nonprobability online panel surveys in Australia*, CSRM & SRC Methods Paper No. 2/2018, Centre for Social Research & Methods, Research School of Social Sciences, College of Arts & Social Sciences, the Australian National University, Canberra.

Peytchev A, Carley-Baxter LR & Black MC (2010). Coverage bias in variances, associations, and total error from exclusion of the cell phone-only population in the United States. *Social Science Computer Review* 28(3):287–302.

Radisich P (2019). Personal communication, 20 June.

RICA (Research Industry Council of Australia) (2016). *Australian market and social research industry survey 2015*, RICA, Glebe.

Rich CL (1977). Is random digit dialing really necessary? *Journal of Marketing Research* 14(3):300–305.

Riillo CAF (2018). Comparing web nonprobability based surveys and telephone probability-based surveys with registers data: the case of Global Entrepreneurship Monitor in Luxembourg.' Paper presented at the Workshop on Probability-Based and Nonprobability Survey Research of Collaborative Research Center SFB 884, University of Mannheim, Mannheim, 25 June 2018.

Roslow S & Roslow L (1972). Unlisted phone subscribers are different. *Journal of Advertising Research* 12(4):35–38.

Saito Y & Lavrakas PJ (2015). Testing the dual frame RDD surveying of the Japanese general population. Paper presented at the 70th annual conference of the American Association for Public Opinion Research, Hollywood, Florida, 15 May 2015.

Sibai AM, Ghandour LA, Chaaban R & Mokdad AH (2016). Potential use of telephone surveys for non-communicable disease surveillance in developing countries: evidence from a national household survey in Lebanon. *BMC Medical Research Methodology* 16:64.

Smith W, Mitchell P, Attebo K & Leeder S (1997). Selection bias from sampling frames: telephone directory electoral roll compared with door-to-door population census: results from the Blue Mountains Eye Study. *Australian and New Zealand Journal of Public Health* 21(2):127–133.

Smyth JD, Dillman DA, Christian LM & O'Neill AC (2010). Using the internet to survey small towns and communities: limitations and possibilities in the early 21st century. *American Behavioral Scientist* 53(9):1423–1448.

Sudman S (1973). The uses of telephone directories for survey sampling. *Journal of Marketing Research* 10(2):204–207.

Teixeira D, Zischke MT & Webley JAC (2016). Investigating bias in recreational fishing surveys: fishers listed public telephone directories fish similarly to their unlisted counterparts. *Fisheries Research* 181:127–136.

Taylor AW, Wilson DH & Wakefield M (1998). Differences in health estimates using telephone and door-to-door survey methods – a hypothetical exercise. *Australian and New Zealand Journal of Public Health* 22(2):223–226.

Tucker C, Brick JM & Meekins B (2007). Household telephone service and usage patterns in the United States in 2004: implications for telephone samples. *Public Opinion Quarterly* 71(1):3–22.

Valliant R & Dever JA (2011). Estimating propensity adjustments for volunteer web surveys. *Sociological Methods & Research* 40(1):105–137.

Vehovar V, Belak E, Bataglej Z & Čikić S (2004). Mobile phone surveys: the Slovenian case. *Metodološki zvezki* 1(1):1–19.

Vicente P & Reis E (2009). The mobile-only population in Portugal and its impact in a dual frame telephone survey. *Survey Research Methods* 3(2):105–111.

WA Department of Health (2018). *Technical report series No 1: design and methodology*, Health Survey Unit, Epidemiology Branch, Public and Aboriginal Health Division, WA Department of Health, Perth.

West LD, Lyle JM, Matthews SR, Stark KE & Steffe AS (2012). *Survey of recreational fishing in the Northern Territory, 2009-10*, Department of Primary Industry and Fisheries, Northern Territory Government, Darwin.

——, Stark KE, Murphy JJ, Lyle JM & Ochwada-Doyle FA (2015). *Survey of recreational fishing in New South Wales and the ACT, 2013/14*, Fisheries Final Report Series No. 149, NSW Department of Primary Industries, Sydney.

Wilson DH, Starr GJ, Taylor AW & Dal Grande E (1999). Random digit dialling and electronic white pages samples compared: demographic profiles and health estimates. *Australian and New Zealand Journal of Public Health* 23(6):627–633.

Wolter KM, Smith P & Blumberg SJ (2010). Statistical foundations of cell-phone surveys. *Survey Methodology* 36(2):203–215.

Yang B & Eyeson-Annan M (2006). Does sampling using random digit dialling really cost more than sampling from telephone directories: debunking the myths. *BMC Medical Research Methodology* 6:6.

Yeager DS, Krosnick JA, Chang L, Javitz HS, Levendusky MS, Simpser AS & Wang R (2011). Comparing the accuracy of RDD telephone surveys and internet surveys conducted with probability and non-probability samples. *Public Opinion Quarterly* 75(4):709–747.