

Disparity in Physical and Mental Multimorbidity Between Aboriginal and Torres Strait Islander people and non-Indigenous Australians: implications for Equity in Health Service use and Work Productivity

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Abstract

Background: Multimorbidity, the presence of ≥ 2 chronic conditions, is a major contributor to health inequalities, with significant impact on health care costs. This study aims to examine the differences in chronic physical and mental health multimorbidity between Aboriginal and Torres Strait Islander people and non-Indigenous Australians, and the effect of multimorbidity on health service use and work productivity amongst Aboriginal and non-Indigenous Australians.

Methods: This study conducted cross-sectional analyses of the Household, Income, and Labour Dynamics in Australia Wave 17, examining a nationally representative sample of 16,749 respondents aged 18 years and above. We applied multivariable linear and logistic regressions to examine the association between multimorbidity and self-reported health, health service use, and employment productivity.

Results: Aboriginal respondents reported a higher prevalence of multimorbidity (24.2%) compared to non-Indigenous Australians (20.7%), and the prevalence of co-existing mental and physical multimorbidity was almost twice as high (16.1% vs 8.1%). Multimorbidity was associated with higher health service use (any overnight admission: AOR 1.52), reduced employment productivity (days sick leave: coef. 0.25), and lower perceived health status (SF6D score: coef. -0.04). These associations are similar in both Aboriginal and non-Indigenous populations.

Conclusions: Multimorbidity prevalence was greater among Aboriginal and Torres Strait Islanders compared to the non-Indigenous population, likely driven by the greater prevalence of mental health conditions reported by the Aboriginal sample. Strategies for better management of mental and physical multimorbidity would not only reduce health care costs among those affected but may contribute to a reduction in health inequalities in Australia.

Key Points:

- Aboriginal and Torres Strait Islander people experience a greater burden of multimorbidity of chronic disease compared to non-Indigenous Australians, of which chronic mental health conditions are a significant component.
- The associations between multimorbidity and health service use, self-reported health, and employment related productivity are similar for both Aboriginal and Torres Strait Islander people, and non-Indigenous Australians.
- Efforts to adequately address chronic health multimorbidity must account for the existing disparity between Aboriginal and non-Indigenous multimorbidity, in order to prevent worsening of current health inequities.
- Building stronger relationships between primary care networks and Aboriginal and Torres Strait Islander people, expanding and endorsing safe cultural practices, and increasing health workforce participation by Indigenous Australians are feasible steps to address this.

Introduction

Non-communicable diseases (NCD) are major contributor to health burden and health inequalities. As NCD prevalence has increased, so too has multimorbidity, the presence of 2 or more chronic health conditions (1). Evidence shows that multimorbidity is associated with poor health and disability (2, 3), increased health service use (1, 4), polypharmacy (5) and poorer work related productivity (4, 6). Multimorbidity contributes to health and financial inequity (1), with the impact greatest among those of lower SES (2).

Australia faces a significant burden from NCDs and multimorbidity, with NCDs being responsible for 90% of all deaths and significant disability (7), while multimorbidity now affects almost a third of all Australians and 80% of

over 65s (8). Anecdotal evidence suggested that the burden of multimorbidity in Australia is not uniform, with Aboriginal and Torres Strait Islander peoples bearing a disproportionate burden (8, 9). While our understanding of the impact of social determinants on the health and wellbeing of an individual has continued to grow, Aboriginal people¹ have historically endured, and continue to endure significant challenges to their health and well-being, impacting on individuals across all ages (10, 11). The health and wellbeing of Aboriginal people has been significantly disrupted since the commencement of colonisation. It is known that colonisation and its ongoing impacts, such as inter-generational trauma, the disruption of family and cultural networks (12, 13), systemic racism and discrimination have all contributed to poorer outcomes and reduced access to opportunities more readily available to non-Indigenous Australians (14, 15). The over representation of NCDs amongst Aboriginal peoples contributes significantly to a pronounced gap in health outcomes between Aboriginal and non-Indigenous Australians (16, 17).

Few studies have examined prevalence of multimorbidity among Aboriginal people (9, 18, 19), and those that have utilised population samples from single states or territories. It is indicated that Aboriginal Australians have a higher prevalence of multimorbidity than Non-Indigenous Australians. There is a lack of research into the prevalence and impact of multimorbidity using a nationally representative sample. Moreover, evidence on disparities in mental and physical multimorbidity amongst Aboriginal and Torres Strait Islander people is lacking (20, 21). To address this important evidence gap, this study aims to examine the nature and prevalence of multimorbidity amongst Aboriginal and non-Indigenous Australians, and its impact on health, health service use and work productivity. Additionally, we investigate whether the impact of multimorbidity varies in these two groups.

¹ The term *Aboriginal people* will be used to respectfully refer to the complete diversity of Australian Aboriginal and Torres Strait Islander peoples, excepting the appropriate use in titles, quotes and references to specific Aboriginal and/or Torres Strait Islander groups.

Methods

Sample

We conducted a cross-sectional analysis of the Household, Income and Labour Dynamics in Australia (HILDA) Survey from 2018 (Wave 17). The HILDA Survey is an annual, nationally representative household-based panel study of Australian residents, designed to collect respondents' information on economic and personal well-being, household dynamics and labour market participation (22). Having started in 2001, the HILDA survey is completed via interviews with all survey household members over the age of 15 years, with the interviews then completed yearly from the same sample. Exempt from the HILDA Survey are Australian overseas residents, diplomatic personnel, members of non-Australian defence forces and people living in very remote areas. Further detailed descriptions of the survey are described elsewhere (23).

Ethics Approval was granted by the Melbourne School of Population and Global Health's Human Ethics Advisory Group at the University of Melbourne, 27th May 2019 (reference number 1954211.1).

Wave 17 had a total of 17, 571 respondents, with a response rate of 96.4%. For this study, we included those respondents aged 18 years and over (n=16,833) and removed respondents with missing values in the dependent or independent variables (0.5% of the sample), leaving a total of 16,749 respondents. A flow chart is included in the Supplementary materials (Appendix Figure 1).

Variables

Multimorbidity

The predicting variable was the number of NCDs, self-reported by respondents in answer to the question *“Have you been told by a doctor or nurse that you have any of these conditions?”*. The HILDA Survey accounts for 12 NCDs; 9 possible physical health conditions (arthritis/osteoporosis, asthma, cancer, chronic bronchitis/emphysema, type 1 diabetes, type 2 diabetes, heart diseases, high blood pressure/hypertension, any other serious circulatory condition), and 3 mental health conditions (depression, anxiety, other mental illness). We examined the number of physical health conditions (0-9) to quantify the number of reported NCDs, as well as recording the presence of any of the three mental health conditions. Respondents were defined as experiencing multimorbidity if they reported two or more of any of these physical or psychological conditions.

We also examine (1) prevalence of physical health condition only multimorbidity (PHM), and (2) prevalence of co-existing physical and mental multimorbidity (PMM).

Outcome variables

Health service use was measured over the previous 12 months, including primary or secondary health service use, as well as medication use. Primary health service use was measured through general practitioner (GP) visits (both any and total number), while secondary health service use was captured through any visit to medical specialists, inpatient hospitalisation(s) and length of stay, and day hospital appointment(s). Medication use was measured as number of medications, as well as presence of polypharmacy (defined as ≥ 5 prescription medications).

Work productivity loss was measured through reduction in labour force participation, any reduced working hours, and days of sick leave or unpaid leave taken.

Health status was assessed through self-reported health (Poor/Fair vs Good/Very Good/Excellent), SF6D score, self-reported disability, and derived psychological distress risk (very high/high vs moderate/low risk of psychological distress), as well as receiving a disability support payment (Disability Support Pension). Unadjusted population level differences in outcomes can be found in Supplementary Materials (Appendix Table 1).

Stratification by Indigenous Status

All respondents were stratified by Indigenous status. Respondents were asked *“Are you of Aboriginal and Torres Strait Islander origin?”*, with those who identified as Aboriginal, Torres Strait Islander, or Aboriginal and Torres Strait Islander determined to be Aboriginal and all other responses considered Non-Indigenous.

Covariates

Covariates included Indigenous status (Aboriginal, Non-Indigenous), sex (Male/Female), age categories (18-29, 30-39, 40-49, 50-59, 60-69, 70+ years), education level (<Year 12 Schooling, Year 12 to Diploma, Bachelors or higher), household income (Q1-Q4), employment status (employed full time, employed part time, not employed but looking for work, not in workforce), marital status (married/de facto, never married/single, formerly married/formerly de facto) location by Australian state or territory (NSW, VIC, SA, WA, TAS, NT, ACT), region (urban, regional, remote), country of birth (Australia, Other), and private health insurance (yes/no).

Statistical analysis

We summarised the sample characteristics. We also presented the prevalence of the most common NCD combinations, and prevalence of PHM and PMM, stratifying by Indigenous status.

We applied multivariable negative binomial, linear and logistic regression models to determine the association between multimorbidity and outcomes (Supplementary Materials - Appendix Table 2). Multivariable logistic regression models were applied to examine the association between multimorbidity and binary outcomes, such as any GP visit, specialist visit or hospital/day hospital admission, as well as unemployment, and self-reported health. Multivariable negative binomial regression models were performed for outcomes modelled on count data such as number of medications, number of days leave, or number of health service interactions (GP/Hospital/Day hospital), given the skewed nature of the count data. A multivariable linear regression model was applied to examine changes in function as reported on the SF6D.

Two-way interaction terms were used in each regression model to examine the difference in association between multimorbidity and outcome differed, between Aboriginal and non-Indigenous Australians. Results are presented for the pooled sample and stratified by Indigenous status.

Results were weighted to account for the multi-stage sampling design of the HILDA Survey. Multivariable regression models were adjusted for covariates listed above. All analyses were performed using Stata 15 (Stata Corp.), sample weights were applied, and the level of statistical significance was set at 5%.

Results

Sample Characteristics

Table 1 displays the characteristics of the sample. Median age of respondents was 46.7 years (IQR=30-61 years). The mean number of NCDs in the total sample was 0.85. The overall prevalence of multimorbidity was 20.8%, and ranged from 5.0% in those aged 18-29 years, to 57.3% in those aged 70 years and above. 97.7% of the sample were non-Indigenous Australians. 51.2% of the sample was female, 78.4% had at least twelve years of education, 64.4% were employed (full or part time), 62.6% were married, the majority lived in an urban region (72.3%) and 52.7% had private insurance.

Amongst the study population, Aboriginal respondents were less likely to report income in the highest quartile (19.1% vs 29.2%), or completion of a Bachelor degree or higher (9.5% vs 29.4%), and were younger, more likely to live in a rural area (49.3% vs 26.0%), and more likely to be unemployed but looking for work (9.3 vs 3.2%). (See Supplementary Materials – Appendix Table 3).

Prevalence and type of multimorbidity

The prevalence of respondents with multimorbidity increased substantially with age in both non-Indigenous and Aboriginal populations, with increasing physical health conditions with increased age contributing significantly. Figure 1 shows the higher prevalence of multimorbidity for Aboriginal respondents, compared to non-Indigenous Australians for all age groups.

Table 2 shows the prevalence of PHM and PMM stratified by Indigenous status and age. The prevalence of PMM was greater amongst Aboriginal respondents compared to Non-Indigenous Australians (16.1% vs 8.1% of total sample), and the inverse was true for PHM (8.1% vs 12.6%). The proportion of respondents with PMM contributed to 67% of total multimorbidity for Aboriginal participants, whilst amongst non-Indigenous Australians, PMM accounted for 39%

of total multimorbidity. It is also worth noting that the high prevalence of mental health conditions significantly contributes to the higher prevalence of total multimorbidity amongst Aboriginal participants. (See Supplementary Materials - Appendix Figure 2).

Prevalence (percentage) of multimorbidity by age (years), by Indigenous Status

Insert Table 2. Multimorbidity prevalence (type) by age, by Indigenous status

Common NCD combinations

There are 45 dyad combinations from the 10 NCDs reported in this study. The most prevalent NCD dyads amongst non-Indigenous Australians were the combinations of asthma and hypertension (7.2%), arthritis and any mental health condition (4.0%), hypertension and any mental health condition (3.4%). Amongst Aboriginal participants, the common combinations were asthma and any mental health condition (8.4%), type2 diabetes and hypertension (6.5%), hypertension and any mental health condition (5.4%). (See Supplementary Materials - Appendix Figure 3).

The associated costs of multimorbidity in two groups

The associations between multimorbidity, health service use, employment productivity and health status are presented in Figure 2. (See Supplementary Materials – Appendix Table 4, 5, 6).

Health service use

Having more NCDs was associated with increased odds of any GP visit (AOR=2.70 95% CI: 2.50 to 2.92), more GP visits (Coefficient = 0.37, 95% CI: 0.30 to 0.44), odds of any overnight hospital admission (AOR= 1.52, 95% CI: 1.46 to 1.58) or day hospital admission (AOR= 1.28, 95% CI: 1.22 to 1.35), more overnight admissions (Coefficient = 0.40, 95% CI: 0.38 to 0.43), nights admitted (Coefficient = 0.52, 95% CI: 0.43 to 0.61), and more day hospital admissions (Coefficient = 0.37, 95% CI: 0.21 to 0.53).

Having multimorbidity was associated with increased odds of visiting a medical specialist in the past 12 months (AOR= 1.62, 95% CI: 1.48, 1.77), increased odds of polypharmacy (AOR=2.86, 95% CI: 2.75 to 2.97), and more prescription medications (Coefficient = 0.55, 95% CI: 0.45 to 0.65). Interactions between number of NCDs and Indigenous status was statistically significant for any specialist visit and number of nights at hospital. Stratified analysis shows a similar impact of having more NCDs on health service use for both Non-Indigenous and Aboriginal people.

Work productivity

Increasing number of NCDs was associated with decreased odds of labour force participation (AOR=0.61, 95% CI: 0.58 to 0.65), increased odds of working reduced hours as opposed to full time (AOR= 1.08, 95% CI: 0.95 to 1.23), higher mean number of paid sick leave days in the previous 12 months (Coefficient = 0.25 95% CI: 0.19 to 0.31), and a higher mean number of days of unpaid leave from work (Coefficient =0.10 95% CI: 0.06 to 0.15).

Perceived health status

Having multimorbidity was associated with increased odds of self-reported health as Fair/Poor, as opposed to Good/Very Good/Excellent (AOR= 2.06, 95% CI: 1.99 to 2.12), increased odds of raised psychological distress risk (AOR= 1.79, 95% CI: 1.50 to 2.14), increased odds of receiving the Disability Support Pension (AOR= 1.39, 95% CI: 1.31 to 1.48) and increased odds of limitations in everyday activities due to health, illness or disability (AOR= 2.61,

95% CI: 2.31 to 2.95). Multimorbidity was associated with a significant decrease in QOL (Coefficient = -0.04, 95% CI: -0.05 to -0.04). The association between number of NCDs and disability support pension, while significant for non-Indigenous participants, was not statistically significant for Aboriginal participants.

Discussion

Utilising data from Wave 17 of the HILDA Survey, we found that multimorbidity was present amongst 20.8% of the pooled sample population, and that prevalence increased with age. The prevalence is greater among Aboriginal people (24.2%) compared to non-Indigenous Australians (20.7%), with the most common combination of NCDs being asthma and hypertension for non-Indigenous Australian respondents, and asthma and any mental health condition for Aboriginal participants. The prevalence of co-existing mental and physical multimorbidity was almost twice as higher for Aboriginal and Torres Strait Islander respondents compared with their counterparts (16.1% vs 8.1%).

Multimorbidity was associated with direct and indirect costs, with increased health service use, decreased work productivity, and reductions in health status amongst those with multimorbidity. These results were largely consistent across both Aboriginal and non-Indigenous respondents, however multimorbidity was found to have no association with likelihood of day hospital use, days of sick leave, part time employment, or receipt of the disability pension for Aboriginal participants.

Comparison with existing literature

These findings are in line with previous literature addressing multimorbidity in Australia. Age, lower socioeconomic status (18), and Indigenous Australian status (9, 18) were found to be associated with increased likelihood of multimorbidity. That Aboriginal people suffer from a greater prevalence, and earlier onset of multimorbidity is consistent with previous literature (9). This is unsurprising, given that Aboriginal people experience a greater burden and earlier onset of chronic disease compared to non-Indigenous Australians (20).

The associations between multimorbidity and health service use is consistent with previous research in the wider Australian population (24). The association between multimorbidity and health service were similar for both groups, albeit a smaller increase in the utilisation of specialist and day hospital services for Aboriginal respondents, possibly an indication of the known unmet need and barriers to accessing care faced by Aboriginal peoples (25, 26). Multimorbidity was similarly associated with unemployment for both Aboriginal and Non-Indigenous Australians, noting national statistics indicate a greater proportion of Aboriginal people are out of work (16). The association between multimorbidity and work outcomes were not consistent for Aboriginal respondents, however this may reflect variance in employment conditions between groups, such as casual labour engagement, or limited access to sick leave. Multimorbidity was associated with a reduction in health status, in keeping with previous literature (3, 27), with poor self-reported health, quality of life, increased likelihood of psychological distress and disability, associations being similar for both stratified samples.

Study Limitations

This study has several important caveats. While the HILDA Survey is considered to be nationally representative, it does not recruit respondents from remote or very remote areas, areas with both greater relative population density of Aboriginal people (28), and lower levels of employment, greater levels of chronic disease, and greater degrees of disability (29). It is difficult to say if the associations found between multimorbidity and outcomes would be relevant in such contexts. There were also identifiable differences between the characteristics of the Aboriginal and non-Indigenous samples that may play a role in explaining at least in part the disparity in findings. Our results have

shown that the Aboriginal respondents were more likely to be younger, lived more remotely, were less wealthy, less highly educated and experienced more employment challenges (see Supplementary Material - Appendix Table 3), all of which could impact their likelihood of experiencing health and wellbeing challenges. Additionally, while the HILDA Survey provides comprehensive information about respondents across a number of metrics, the data is primarily self-reported. This exposes risks of self-report bias; as errors in reporting health conditions, or poor recall about health, which may cause under-reporting of the prevalence of multimorbidity (8). It is possible that self-report bias differs between Aboriginal and Non-Indigenous Australians. This is especially likely considering cultural differences that exist in relation to conceptualisations of health. For instance, within Aboriginal cultures and languages, disability (as a Western construct) does not exist. For Aboriginal peoples, disability is not a defining characteristic of a person that categorically separates them from people without a disability (19). Further research is needed that employs more objective data collection methodologies.

Due to known barriers in accessing health services for Aboriginal peoples (30), it is likely that there is a degree of undiagnosed chronic illness, underestimating the prevalence of multimorbidity for this group (31). Finally, while the HILDA Survey captures health service use, productivity loss and self-reported health, this data is observational not causal. Increased health service use in a multimorbid individual may be the result of something independent of multiple chronic health conditions, and inversely low rates of health service use may indicate a lack of supply or barriers to accessing care, as opposed to a lack of need for services or mistrust in services.

Policy and Clinical Implications

The associations identified within this study provide additional evidence of the substantial societal cost of multimorbidity. Reductions in multimorbidity and its implications would see returns in both improved health and work productivity, and reductions in health service use. Although the findings demonstrate that multimorbidity is a challenge faced by all Australians, this research exposes and quantifies the disparity in the prevalence, epidemiology and burden of multimorbidity amongst Aboriginal peoples and Non-Indigenous Australians. The findings suggest that multimorbidity is disproportionately impacting Aboriginal peoples and that mental health conditions may play a substantive role in this disproportionality. This is particularly important as Aboriginal people often experience additional barriers to accessing mental health services than their non-Indigenous counterparts.

It is clear there is an established need for improvement in multimorbidity management and prevention (32), and clinical guidelines for multimorbidity such as the UK's NICE highlight both multi-disease models, and the need to address social determinants of health (33). In the Australian context, there is recognition of the impact of both social and early life determinants on health (34), as well as the need for culturally safe and appropriate care to reduce health inequities experienced by Aboriginal peoples (35). There is a growing body of evidence for a number of strategies to target the disparity in NCD rates for Aboriginal communities. Adoption of multimorbid primary care models should be supported by the expansion of Indigenous health worker training and culturally safe practices to address the experiences of racism and discrimination endured by Aboriginal people accessing health care (26). Building stronger relationships between primary health services and Aboriginal communities would facilitate both improvements in service utilisation rates, and appropriate primary health service design (36, 37), while expansion of programs to address health literacy amongst those with chronic disease would see greater control over health and wellbeing (38). Aboriginal respondents were also more likely to reside in remote areas where there is a need to strengthen health and medical services.

Those with multimorbidity face financial risk through increased health service, and medication use, in turn compounded by the reduced likelihood of employment, and higher number of days of paid sick or unpaid leave. Our

findings indicate that Aboriginal people may be at heightened risk of financial hardship due to their higher prevalence of multimorbidity. Aboriginal respondents reported high levels of PMM and similar levels of overall physical multimorbidity despite being a younger cohort overall. They reported similar levels of engagement in medical services to their non-Indigenous counterparts while also being far less likely to possess private health insurance to cover the cost of treatments. The association identified in this study between multimorbidity and unemployment, as well as sick leave, may indicate a need to further invest in workplace flexibility and support by employers to facilitate greater productivity amongst those with multimorbidity. An area of future research would be to address what factors may keep multimorbid respondents in the workforce for longer. Furthermore, future research is warranted to better understand the financial impact of multimorbidity for Aboriginal peoples and how organisations can support them to maintain employment and financial stability.

Conclusion

Our study highlighted substantial disparities in mental and physical multimorbidity amongst Aboriginal and non-Aboriginal population in Australia. Decisive actions are needed to improve prevention and management of multimorbidity and alleviate the effect of chronic diseases in Australia.

Declarations

Ethics approval and consent to participate:

Ethics Approval was granted by the Melbourne School of Population and Global Health's Human Ethics Advisory Group at the University of Melbourne, 27th May 2019 (reference number 1954211.1).

Consent for Publication:

Not applicable.

Availability of data and materials:

The dataset supporting the conclusions of this article is available at the Australian Government's National Centre for Longitudinal Data Dataverse [<https://dataverse.ada.edu.au/dataverse/nclcd>]. All applicants and collaborators who wish to view record data must complete and sign a confidentiality deed poll.

Competing interests:

The authors declare that no conflict of interest exists.

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Authors' contributions:

WC developed the hypothesis and methods, obtained the data and analysed the data and results. MI analysed the data and results, contributed to the methodology and manuscript. JT provided valuable insight from a mental health and indigenous perspective and assisted with policy implications. KA and GS assisted in drafting and revising the final manuscript. GA, BO and JL all assisted with the policy implications (health care and productivity loss), as well as providing depth of insight on Multimorbidity. All authors have reviewed and approved this manuscript.

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References

1. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;380(9836):37-43.
2. Jackson CA, Jones M, Tooth L, Mishra GD, Byles J, Dobson A. Multimorbidity patterns are differentially associated with functional ability and decline in a longitudinal cohort of older women. *Age Ageing*. 2015;44(5):810-6.
3. Palladino R, Tayu Lee J, Ashworth M, Triassi M, Millett C. Associations between multimorbidity, healthcare utilisation and health status: evidence from 16 European countries. *Age Ageing*. 2016;45(3):431-5.
4. Wang L, Palmer AJ, Otahal P, Cocker F, Sanderson K. Multimorbidity and Health Care Service Utilization in the Australian Workforce: Findings From the National Health Survey. *J Occup Environ Med*. 2017;59(8):795-802.
5. Taylor CJ, Harrison C, Britt H, Miller G, Hobbs FR. Heart failure and multimorbidity in Australian general practice. *J Comorb*. 2017;7(1):44-9.
6. Mitchell RJ, Bates P. Measuring health-related productivity loss. *Popul Health Manag*. 2011;14(2):93-8.
7. Australian Institute of Health and Welfare. Chronic conditions and disability 2015. AIHW: Canberra; 2018.
8. Lujic S, Simpson JM, Zwar N, Hosseinzadeh H, Jorm L. Multimorbidity in Australia: Comparing estimates derived using administrative data sources and survey data. *PLoS One*. 2017;12(8):e0183817.
9. Randall DA, Lujic S, Havard A, Eades SJ, Jorm L. Multimorbidity among Aboriginal people in New South Wales contributes significantly to their higher mortality. *Med J Aust*. 2018;209(1):19-23.
10. Paradies Y, Harris R, Anderson I. The impact of racism on indigenous health in Australia and Aotearoa: towards a research agenda. Casuarina, N.T.: Cooperative Research Centre for Aboriginal Health; 2008.
11. Awofeso N. Racism: a major impediment to optimal Indigenous health and health care in Australia. *Australian Indigenous Health Bulletin*. 2011;11.
12. Sherwood J. Colonisation - it's bad for your health: the context of Aboriginal health. *Contemp Nurse*. 2013;46(1):28-40.
13. Paradies Y. Colonisation, racism and indigenous health. *Journal of Population Research*. 2016;33(1):83-96.
14. Dudgeon P, Wright M, Paradies Y, Garvey D, Walker I. The Social, Cultural and Historical Context of Aboriginal and Torres Strait Islander Australians. Working Together: Aboriginal and Torres Strait Islander Mental Health and Wellbeing Principles and Practice. Barton, ACT: Australian Government Department of Health and Ageing; 2010. p. 25-42.
15. Henry BR, Houston S, Mooney GH. Institutional racism in Australian healthcare: a plea for decency. *Medical Journal of Australia*. 2004;180(10):517-20.
16. Australian Government Department of the Prime Minister and Cabinet. Closing the Gap Prime Minister's Report 2018. Canberra, Australia: Commonwealth of Australia; 2018.
17. Vos T, Barker B, Begg S, Stanley L, Lopez AD. Burden of disease and injury in Aboriginal and Torres Strait Islander Peoples: the Indigenous health gap. *Int J Epidemiol*. 2009;38(2):470-7.
18. Brett T, Arnold-Reed DE, Troeung L, Bulsara MK, Williams A, Moorhead RG. Multimorbidity in a marginalised, street-health Australian population: a retrospective cohort study. *BMJ Open*. 2014;4(8):e005461.

19. Avery S. Culture is Inclusion: A narrative of Aboriginal and Torres Strait Islander people with disability. Sydney, NSW: First Peoples Disability Network; 2018.
20. Australian Institute of Health and Welfare. The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples 2015. Canberra: AIHW; 2015.
21. Jorm AF, Bourchier SJ, Cvetkovski S, Stewart G. Mental health of Indigenous Australians: a review of findings from community surveys. *Medical Journal of Australia*. 2012;196(2):118-21.
22. Wilkins R, Lass I. The Household, Income and Labour Dynamics in Australia Survey: Selected Findings from Waves 1 to 16. Melbourne Institute: Applied Economic & Social Research; 2018.
23. Wooden M, Freidin S, Watson N. The Household, Income and Labour Dynamics in Australia (HILDA) Survey: Wave 1. *The Australian Economic Review*. 2002;35(3):339-48.
24. Glynn LG, Valderas JM, Healy P, Burke E, Newell J, Gillespie P, et al. The prevalence of multimorbidity in primary care and its effect on health care utilization and cost. *Fam Pract*. 2011;28(5):516-23.
25. Marrone S. Understanding barriers to health care: a review of disparities in health care services among indigenous populations. *Int J Circumpolar Health*. 2007;66(3):188-98.
26. Davy C, Harfield S, McArthur A, Munn Z, Brown A. Access to primary health care services for Indigenous peoples: A framework synthesis. *International Journal for Equity in Health*. 2016;15(1):163.
27. Marengoni A, Angleman S, Melis R, Mangialasche F, Karp A, Garmen A, et al. Aging with multimorbidity: a systematic review of the literature. *Ageing Res Rev*. 2011;10(4):430-9.
28. Australian Bureau of Statistics. 3238.0.55.001 - Estimates of Aboriginal and Torres Strait Islander Australians, June 2016 Canberra, Australia: Australian Bureau of Statistics; 2018 [Available from: <https://www.abs.gov.au/AUSSTATS/abs@.nsf/Latestproducts/3238.0.55.001Main%20Features1June%202016?opendocument&tabname=Summary&prodno=3238.0.55.001&issue=June%202016&num=&view=>].
29. Australian Institute of Health and Welfare. Australia's health 2018. Canberra: AIHW; 2018.
30. Australian Institute of Health and Welfare. Aboriginal and Torres Strait Islander Health Performance Framework (HPF) report 2017 2018 [Available from: <https://www.aihw.gov.au/reports/indigenous-australians/health-performance-framework>].
31. Productivity Commission. Disability Care and Support. Canberra, ACT; 2011.
32. The Academy of Medical Sciences. Multimorbidity: a priority for global health research. London, UK;: The Academy of Medical Sciences; 2018.
33. Kernick D, Chew-Graham CA, O'Flynn N. Clinical assessment and management of multimorbidity: NICE guideline. *Br J Gen Pract*. 2017;67(658):235-6.
34. Hoy WE. Chronic disease care in remote Aboriginal Australia has been transformed. *BMJ*. 2013;347:f6127.
35. Peiris D, Brown A, Cass A. Addressing inequities in access to quality health care for indigenous people. *CMAJ*. 2008;179(10):985-6.
36. Zhao Y, Thomas SL, Guthridge SL, Wakerman J. Better health outcomes at lower costs: the benefits of primary care utilisation for chronic disease management in remote Indigenous communities in Australia's Northern Territory. *BMC Health Serv Res*. 2014;14:463.
37. Gibson O, Lisy K, Davy C, Aromataris E, Kite E, Lockwood C, et al. Enablers and barriers to the implementation of primary health care interventions for Indigenous people with chronic diseases: a systematic review. *Implement Sci*. 2015;10:71.

38. Rheault H, Coyer F, Jones L, Bonner A. Health literacy in Indigenous people with chronic disease living in remote Australia. *BMC Health Serv Res.* 2019;19(1):523.

Tables

Table 1. Sample characteristics and prevalence of multimorbidity

Variables	Total n (%)	Multimorbidity prevalence % (95% CI)
Overall	16749 (100)	20.8 (13.4, 30.7)
Multimorbidity		
Zero NCDs	8583 (53.0)	
Single NCD	4552 (26.2)	
2 NCDs	2099 (11.7)	
3 NCDs	916 (5.4)	
4 NCDs	599 (3.7)	
Indigenous Status		
Non-Indigenous	16240 (97.7)	20.7 (13.4, 30.6)
Aboriginal and Torres Strait Islander	509 (2.3)	24.2 (16.9, 33.4)
Gender		
Male	7880 (48.8)	18.4 (12.7, 26.1)
Female	8869 (51.2)	23.0 (14.2, 35.1)
Age (years)		
18-29	3860 (22.0)	5.0 (2.2, 11.0)
30-39	2934 (18.0)	6.4 (4.5, 9.0)
40-49	2706 (17.7)	11.9 (5.6, 23.4)
50-59	2753 (16.3)	23.0 (18.8, 27.8)
60-69	2258 (13.4)	40.2 (33.3, 47.5)
70+	2238 (12.8)	57.3 (54.3, 60.2)
Marital status		
Married/De Facto	11026 (62.6)	20.5 (14.4, 28.3)
Single/Never Married or De Facto	3405 (24.2)	10.6 (5.1, 20.5)
Former Married/De Facto	2318 (13.3)	40.9 (32.1, 50.3)
Education Level		
<Year 12 Schooling	3840 (21.6)	37.9 (33.4, 42.7)
Year 12 to Diploma	8325 (49.5)	18.6 (13.6, 24.9)
Bachelors or Higher	4584 (28.9)	11.8 (8.3, 16.4)
Employment Status		
Employed Full Time	7326 (44.5)	8.3 (5.8, 11.7)

Employed Part Time	3398 (19.9)	12.2 (6.7, 21.4)
Not employed	603 (3.2)	19.5 (15.1, 24.9)
Not in workforce	5394 (32.4)	43.3 (35.5, 51.6)
Annual income		
1st quantile (lowest)	4189 (20.3)	40.1 (32.1, 48.8)
2nd quantile	4187 (24.2)	21.5 (14.6, 32.2)
3rd quantile	4186 (25.9)	14.0 (9.4, 20.3)
4th quantile (highest)	4187 (29.7)	12.9 (10.8, 15.4)
Region		
Urban	11041 (72.3)	18.4 (16.1, 21.0)
Regional	5461 (26.5)	27.2 (22.2, 32.8)
Remote	247 (1.2)	21.8 (11.5, 37.5)
State		
NSW	4875 (32.2)	21.1 (12.0, 34.4)
VIC	4251 (26.2)	19.3 (13.7, 26.5)
QLD	3583 (19.7)	21.0 (14.0, 30.3)
SA	1532 (7.2)	25.2 (18.1, 33.9)
WA	1479 (10.2)	20.5 (11.0, 34.9)
Tasmania	548 (2.2)	25.4 (19.1, 32.8)
NT	127 (0.7)	13.5 (11.6, 15.7)
ACT	354 (1.7)	14.8 (10.2, 21.1)
Country of birth		
Australia	13154 (69.6)	20.9 (13.6, 30.8)
Other	3595 (30.4)	20.4 (13.3, 30.0)
Private health		
No private insurance	8095 (47.3)	22.9 (15.8, 32.0)
Yes private insurance	8654 (52.7)	18.9 (11.9, 28.6)
* Values are unweighted counts and weighted percentages unless otherwise indicated		

Table 2. Multimorbidity prevalence (type) by age, by Indigenous status

Age group	All multimorbidity (n,%)		Physical only multimorbidity (n,%)		Co-existing physical and mental condition (n,%)	
	Non-Indigenous	Aboriginal	Non-Indigenous	Aboriginal	Non-Indigenous	Aboriginal
18-29	208 (4.81)	24 (10.3)	16 (0.4)	1 (0.3)	192 (4.4)	23 (10.1)
30-39	232 (6.22)	13 (14.0)	34 (0.9)	2 (1.0)	198 (5.3)	11 (13.0)
40-49	323 (11.5)	23 (28.5)	111 (4.2)	5 (5.2)	212 (7.3)	18 (23.3)
50-59	605 (22.7)	32 (39.2)	316 (11.9)	17 (21.5)	289 (10.8)	15 (17.8)
60-69	867 (40.0)	15 (51.7)	593 (29.1)	6 (17.7)	274 (10.9)	9 (43.0)
70+	1259 (57.1)	13 (72.9)	983 (44.5)	11 (57.8)	276 (12.7)	2 (15.2)
Total	3494 (20.7)	120 (24.2)	2053 (12.6)	42 (8.1)	1441 (8.08)	78 (16.1)

Figures

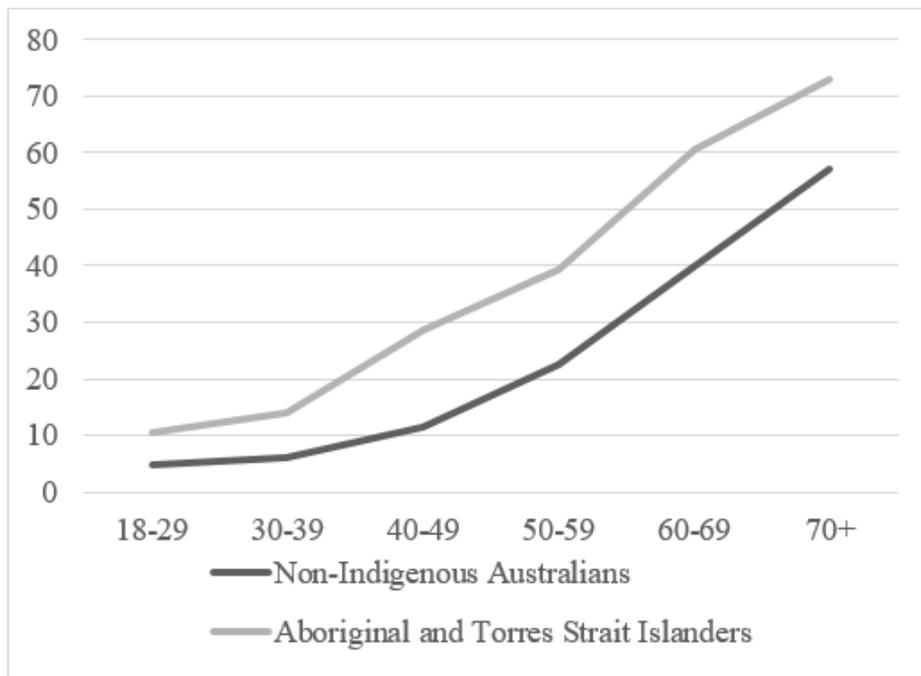


Figure 1

The prevalence of multimorbidity by age and indigenous status Prevalence (percentage) of multimorbidity by age (years), by Indigenous Status

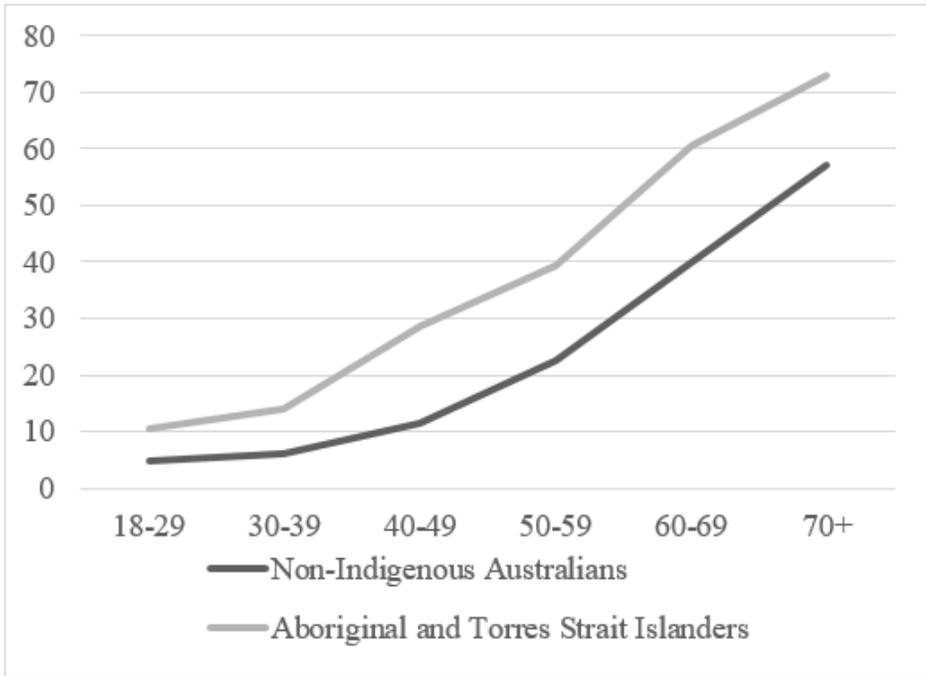


Figure 1

The prevalence of multimorbidity by age and indigenous status Prevalence (percentage) of multimorbidity by age (years), by Indigenous Status

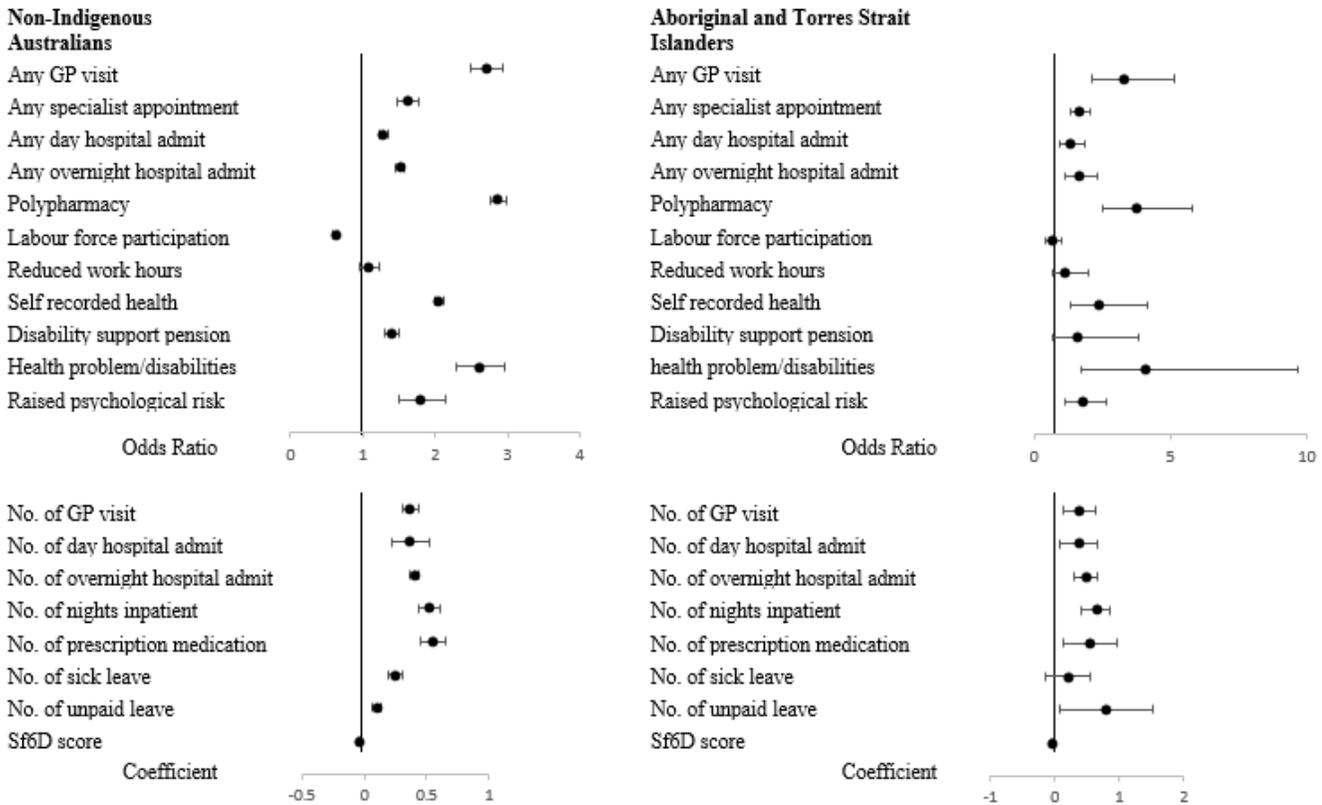


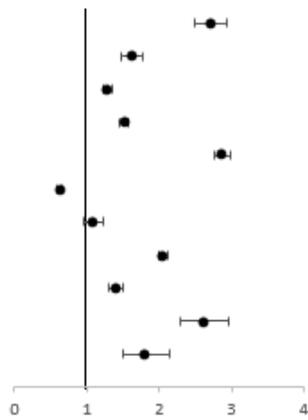
Figure 2

Impact of multimorbidity on health service use, work productivity, and self-reported health by Indigenous status

Non-Indigenous Australians

- Any GP visit
- Any specialist appointment
- Any day hospital admit
- Any overnight hospital admit
- Polypharmacy
- Labour force participation
- Reduced work hours
- Self recorded health
- Disability support pension
- Health problem/disabilities
- Raised psychological risk

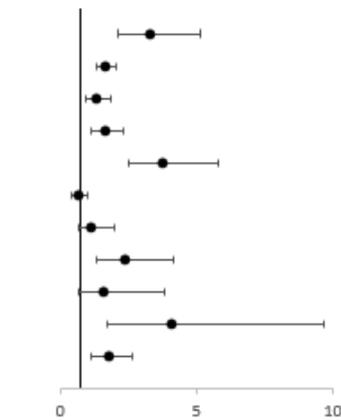
Odds Ratio



Aboriginal and Torres Strait Islanders

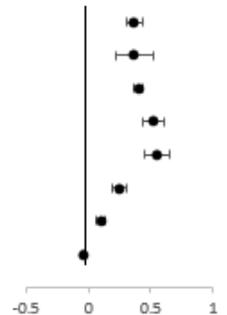
- Any GP visit
- Any specialist appointment
- Any day hospital admit
- Any overnight hospital admit
- Polypharmacy
- Labour force participation
- Reduced work hours
- Self recorded health
- Disability support pension
- health problem/disabilities
- Raised psychological risk

Odds Ratio



- No. of GP visit
- No. of day hospital admit
- No. of overnight hospital admit
- No. of nights inpatient
- No. of prescription medication
- No. of sick leave
- No. of unpaid leave
- Sf6D score

Coefficient



- No. of GP visit
- No. of day hospital admit
- No. of overnight hospital admit
- No. of nights inpatient
- No. of prescription medication
- No. of sick leave
- No. of unpaid leave
- Sf6D score

Coefficient

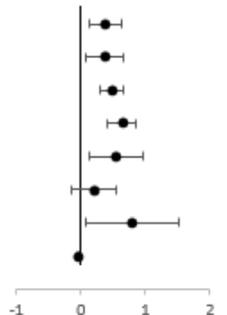


Figure 2

Impact of multimorbidity on health service use, work productivity, and self-reported health by Indigenous status

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