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March 2005

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Institute for the Study
of Labor

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ABSTRACT

The Health Status of Indigenous and Non-Indigenous Australians*

We use unique survey data to examine the determinants of self-assessed health of Indigenous and non-Indigenous Australians. We explore the degree to which differences in health are due to differences in socio-economic factors, and examine the sensitivity of our results to the inclusion of 'objective' health measures. Our results reveal that there is a significant gap in the health status of Indigenous and non-Indigenous Australians, with the former characterised by significantly worse health. These findings are robust to alternative estimation methods and measures of health. Although between one third and one half of the health gap can be explained by differences in socio-economic status - such as income, employment status and education - there remains a large unexplained component. These findings have important policy implications. They suggest that, in order to reduce the gap in health status between Indigenous and non-Indigenous Australians, it is important to address disparities in socio-economic factors such as education. The findings also suggest that there are disparities in access to health services and in health behaviour. These issues need to be tackled before Australia can truly claim to have 100% health-care coverage and high levels of health and life expectancy for *all* of its population.

JEL Classification: I1, I12

Keywords: self-assessed health, Indigenous health

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1. Introduction

Although on average Australians have good health, the average life expectancy at birth of Indigenous Australians is just 56 years for men and 63 years for women, while the average life expectancy of non-Indigenous Australians is approximately 20 years longer.[1] Why do Indigenous Australians have health outcomes worse those of other Australians? How much of the difference in health outcomes is driven by socio-economic variables such as income and labour market status, and how much is explained by medical, historical, behavioural and environmental factors? In this paper we aim to address some of these important questions.

The history of Indigenous Australians is in some ways similar to that of the Indigenous populations of Canada, New Zealand and the United States. Traditional life of Indigenous cultures was affected by the arrival of European settlers. Populations were dispossessed of land, there was forcible relocation and Indigenous populations were vulnerable to diseases brought from Europe (Ring and Brown, 2002). However, the health gap between the Indigenous population and the rest is far larger in Australia than in Canada, US and New Zealand. For example, the gap in life expectancy is 20 years in Australia compared with a gap of 5 to 10 years in the other countries (AMA, 2002). Indigenous Australians not only have worse health than other Australians, they have worse health than similar comparable Indigenous populations.

The relatively poor health position of Aborigines and Torres Strait Islanders in Australia (denoted as Aborigines or Indigenous henceforth) suggests there are Australia-specific factors at work. The health gap could be driven by differential delivery of health services, by socio-economic factors reflecting the less privileged position of Aborigines, or by the health behaviour of Aborigines (for example smoking), or by some combination of all three.[2] In this paper we aim to investigate the degree to which socio-economic variables explain the gap in health status, as compared to health behaviour such as smoking, or if the explanation is more likely to be related to health service delivery and health behaviours.

[1] These data are from the Australian Bureau of Statistics for the period 1998-2000. In the descriptive statistics below the high levels of hospitalisation, diabetes and poor ratings of self-reported health for Indigenous people are also highlighted. According to AIHW (2004) the leading causes of death for the Indigenous population were diseases of the circulatory system, injury and poisoning, cancers, respiratory diseases and endocrine or metabolic diseases. In addition, Indigenous Australians have high rates of suicide.

[2] AIHW (2004) splits the determinants of health into 5 categories – biomedical factors (health services), health behaviours, socio-economic characteristics, genetic factors and environmental factors. Our focus is on the first three factors. However, part of the gap may be driven by genetic factors and the different environmental effects in remote locations (where Indigenous people are more likely to live). We are unable to control for these.

Aborigines are more likely to have lower levels of social and economic resources, as will be revealed by descriptive statistics later in this paper. It is well-established that health can be affected by socio-economic factors and on all of these measures Aboriginal Australians fare badly. They are less likely to have formal qualifications; they are more likely to have lower income levels; and they are more likely to be unemployed. In addition they are more likely to engage in activities such as smoking that are deleterious to health and to suffer from obesity and high-risk consumption of alcohol.

Australia's health system differs from health systems in Europe and North America and Australia claims 100% coverage (see for example Docteur and Oxley, 2003). Health services are primarily funded by the federal, state and territory governments, and private health insurers. Individual Australians make contributions to their health services through the tax system, private health insurance payments, and in many instances through a co-payment at the time of, or after, consultation. In general, people on lower incomes are able to benefit from Government assistance for the cost of health services. Health services are delivered in a decentralised way with patients selecting their General Practitioner, hospital or other health professional (based on advice from medical professionals). In addition, there are a variety of public health services provided through the state and federal Governments (for more details see AIHW, 2004).

Socio-economic status (SES) can affect health through a variety of transmission mechanisms.[3] Overall, it might affect health through relative ranking in society, access to resources and social inclusion. Specific factors might also be important. Health could be affected by absolute income (through nutrition and working and living conditions) or by relative income (through power, control and access to resources). Alternatively, health might be related to non-income related factors such as employment status (through stress and social exclusion) and education (through information about health).

Past socio-economic status and previous health decisions are important in determining current health. Grossman (1972) highlights the importance of previous investments in health on current health. There is also a related recent literature stressing the link between socio-economic factors experienced in early childhood and subsequent health outcomes (see *inter alia* Case *et al*, 2002; Currie *et al*, 2004). Thus current income may be significantly related

[3] Kreiger *et al* (1997) state that socio-economic status is comprised of (*a*) actual resources, and (*b*) status, meaning prestige- or rank-related characteristics. In their discussion of socio-economic indicators they include: income, poverty, material and social deprivation, wealth, education and prestige type indicators (such as Duncan's Socioeconomic Index (SEI) - a composite score based on information pertaining to occupational prestige, income and education).

to health because of a contemporaneous relationship or because it is correlated with previous income that affects current health through earlier behaviour and experiences.

Empirical studies have generally found a strong association between socio-economic variables and health status (see Lahelma *et al*, 2004; WHO, 1998). However the direction of causality remains an issue. The results have been tested for sensitivity to a wide variety of omitted variables, including the usual demographic variables, and also a wide range of socio-economic and health risk variables. Yet there has been little research investigating whether or not disparities in SES explain variations in health outcomes across ethnic groups,[4] although Lillie-Blantan and Laveist (1996) conclude that socio-economic conditions are a powerful, although not necessarily exclusive, explanatory variable for racial disparities in health.

In this paper we use unique survey data to examine the determinants of self-assessed health outcomes of Indigenous and non-Indigenous Australians. In our analysis we explore the degree to which differences in health are due to differences in socio-economic status and examine the sensitivity of our results to the inclusion of 'objective' health measures. Such an investigation has not, to our knowledge, been undertaken before. And yet Australia is an especially important case study because of the relatively poor health outcomes of Indigenous Australians.[5] If the reason for the disparity in health status across groups is primarily driven by socio-economic factors, it could be argued that these are the factors that need to be addressed to reduce the disparity.[6] However, if the health gap remains significant even after controlling for SES, then the observed gaps may be partly or fully explained by historical factors, behavioural factors or by the way that health services are delivered.

The remainder of this paper is structured as follows: Section 2 describes the data and Section 3 presents the descriptive statistics. The results from the examination of the link between health, SES and Indigenous status are reported in Section 4. Section 5 presents additional results that show the results are robust to different estimation methods and to an alternative dependent variable. Section 6 concludes.

To summarise, our results reveal that there is a significant gap in the health status of Aboriginal and non-Aboriginal Australians and that between one third and one half of the

[4] Hayward *et al* (2000) and Cooper (2002), using respectively US and British data, estimate the degree to which socio-economic status explains variations in health status across ethnic groups.

[5] Gray et al (2004) use the 1995 National Health Survey to investigate differences in health expenditure and health utilisation across Indigenous and non-Indigenous people. The 1995 NHS did not sample the Indigenous population in remote areas, in contrast to the 2001 NHS.

[6] It may be that Government policy can more tightly target SES material deprivation factors relating to health (such as income and poverty), rather than SES rank or prestige factors (such as occupational composition and social exclusion).

gap can be explained by differences in socio-economic status. Our findings are robust to alternative estimation methods and measures of health status. The policy implications are broad. In order to reduce the gap in health status, it is important not only to address socio-economic status but also to examine disparities in access to health services and in health behaviour.

2. Data Source and Variables

Our data source is the Australian Bureau of Statistics' 2001 National Health Survey (NHS), conducted Australia-wide between February and November. This survey is unique in over-sampling the Indigenous population and women. It also contains a remarkably rich set of information on health status, use of health services, health-related aspects of respondents' lives (such as body mass, smoking, and exercise patterns), socio-economic factors, and demographic attributes. The principal drawback of the survey is that it is cross-sectional, making it difficult to investigate causality. Thus our estimates should be interpreted as correlations rather than as establishing causality.[7]

When surveying the Indigenous population, the NHS interviewers were usually accompanied by local Indigenous facilitators, who explained the purpose of the survey, assisted in identifying the usual residents of a household and locating residents who were not at home, and assisted respondent understanding of the questions. Sampling was done at the household level and one person in the household aged 18 years and over in each dwelling was selected and interviewed about their health.[8]

The definition of Indigenous status in the NHS is self-reported. Of course, individuals answering affirmatively to this question may differ in their ties to specific Indigenous and non-Indigenous cultures, main language spoken at home, living arrangements and ancestral links. Therefore in our analysis we experiment with disaggregating Indigenous respondents by whether they live in remote or non-remote areas,[9] and by main language spoken at home.

[7] For instance, Aborigines may have worse health that leads to poorer socio-economic status. But likewise they may have poorer socio-economic status, which in turn causes worse health outcomes. Alternatively a third omitted variable may be correlated with both socio-economic status and health outcomes, and hence our estimates might suffer from omitted variable bias. Panel data allow one to control for such unobserved heterogeneity but there are no panel data sources suitable for examining differential health outcomes of Aborigines and non-Aborigines. Moreover there are no obvious instruments in our data source.

[8] This was a usual resident aged 18 years or more whose birthday was closest after the date of interview.

[9] As we note below there is some concern that Indigenous populations whose primary language is not English and/or who live in remote areas may report there health conditions differently from the rest of the population (see Sibthorpe et al., 2001). To correct for this, we include a separate dummy variable for the remote sample. We also undertake a range of sensitivity analyses to explore the robustness of our results to alternative dependent variables and the inclusion of a wide range of health variables.

Unfortunately in the 2001 National Health Survey, while the Indigenous population living in remote areas were included in the sampling frame, the non-Indigenous population living in remote areas were not included in the frame.

For reasons of confidentiality, the NHS Indigenous data can only be accessed using the Australian Bureau of Statistics' remote access data link (RADL). The complete dataset contains 30,060 records, 21,020 of which have valid health status data (primarily because only adults provide these data, although a small number of adults did not respond). The first panel of Table 1 shows the composition of the sample by Indigenous status and location.[10] Of the 9,599 male records, 8,711 are non-Indigenous, 496 are Indigenous living in non-remote areas and 392 are Aboriginal males living in remote areas. Of the 11,421 female records, 10,206 are non-Indigenous, 699 are non-remote Indigenous and 516 are remote Indigenous. The second panel of Table 1 shows the number of people in each group. In 2001 there were approximately 18.6 million non-Indigenous people, 320,000 Indigenous people living in non-remote areas and 120,000 Indigenous people living in remote areas.

Table 1: Basic descriptive statistics[i]

a: Sample size by Indigenous status and remoteness		
	Males	**Females**
Non-Indigenous	8711	10206
Indigenous – non-remote	496	699
Indigenous – remote	392	516
b: Number of people by Indigenous status and remoteness (millions)		
	Males	**Females**
Non-Indigenous	9.191	9.354
Indigenous – non-remote	0.158	0.163
Indigenous – remote	0.060	0.062
c: Distribution of self-assessed health (how is your health overall?)		
	Frequency (millions)	**%**
Poor	0.716	5
Fair	1.997	14
Good	4.557	37
Very Good	4.913	49
Excellent	2.828	13
d: Distribution of hospitalisation (have you been hospitalised over the past 12 months?)		
	Frequency (millions)	**%**
No	16.679	88
Yes	2.309	12

i. Note: values in panels (b), (c) and (d) are population totals using ABS weights.

[10] Unfortunately the NHS Indigenous survey data available on the RADL provide no state or territory geographical information. This information may be particularly relevant, first because health service delivery is primarily done at the state level and second, because there were some historical differences in Indigenous treatment across states. The authors are currently investigating if further estimation can be undertaken with state level dummies included.

The primary health variable used in our analysis is self-reported health, based on responses to the question: "In general would you say that your health is Excellent, Very Good, Good, Fair or Poor?". From the responses to this question we construct a categorical variable for self-assessed health, taking the value 1=poor, 2=fair; 3=good; 4=very good; 5=excellent. This categorical variable is used as the dependent variable in our ordered logit specifications when we estimate the determinants of self-assessed health status.[11] In addition we estimate several binary logit specifications in which the dependent variable is constructed from responses to the question of "Have you been hospitalised over the past 12 months?".

The distribution of the self-assessed health and hospitalisation variables is given in the last two panels of Table 1. Some 5% of people rate their health as 'poor', 14% as 'fair', 37% as 'good', 49% as 'very good' and 13% as 'excellent'. In addition, note that 12% people have been hospitalised over the past year and 88% have not been hospitalised over the past year.

An interesting issue is whether or not self-assessed measures of health are appropriate indicators of respondents' actual health. This might be of especial concern in making comparisons between Aboriginal and non-Aboriginal health, as suggested by Sibthorpe et al., 2001. In our estimation we therefore check if more 'objective' measures (such as smoking rates, alcohol consumption and diabetes rates) are highly correlated with self-assessed health. We also investigate if this relationship differs systematically across groups. If our groups of interest respond differently to questions about self-assessed health, then observed health gaps might be an artefact of heterogenous perceptions rather than true measures of actual health.

Appendix 3 shows the means of all variables used in our analysis. We see that 16% of our sample is aged 15-24 years, 40% is aged 25-44 year, 32% aged 45-69 years and 12% aged 70 years and over. We also see that 54% of our sample is female, 52% are married, 6% are non-remote Indigenous and 4% are remote Indigenous. This sample composition is partly due to the over-sampling of Indigenous people and women in the sample design. All our descriptive statistics are weighted but our regressions results are not.

[11] Crossley and Kennedy (2002) analyse the stability of the self-reported health measure using the 1995 National Health Survey. In the 1995 survey, unlike the 2001 NHS, the self assessed health question was asked twice during the interview process. Crossley and Kennedy (2002) compared the results from the two different questions to check the stability of their self assessed health variable. While there was some instability in the reporting of self assessed health (28% of respondents change their self assessed category between questions), only 3% changed their category by more than 1 category. Older people, people who reported their health as 'good' and people on low incomes were more likely to revise their health category.

3. Descriptive statistics

Table 2 shows the percentage of people who rate their health "fair" or "poor", disaggregated by Indigenous status, sex, age, main language and location. All non age-specific data have been age standardised (using the ABS weights) to take account of the fact that the Indigenous population is younger than the non-Indigenous population. Table 2 reveals that Indigenous Australians are more likely to rate their health as "fair" or "poor" - referred to as poor from here onwards for expositional simplicity. Eighteen percent of non-Indigenous people rate their health as poor compared to 34% of Indigenous males living in non-remote areas and 37% of Indigenous females living in non-remote areas. It is interesting that there is no statistically significant difference in the proportions rating health 'poor' of Indigenous males living in a remote area (and who are more likely to speak an Indigenous language at home) and non-Indigenous males (21% compared to 18%).

Table 2: Descriptive statistics of self assessed health measure[i, ii]

a: Percentage of population rating health poor by Indigenous status and remoteness		
	Males	**Females**
Non-Indigenous	18	18
Indigenous – non-remote	34	37*
Indigenous - remote	21	32
b: Percentage of population rating health poor by Indigenous status and main language		
	Males	**Females**
Non-Indigenous – English	19	17
Non-Indigenous- other	21	23*
Indigenous- English	34*	38*
Indigenous- Indigenous	20	31*
Indigenous – other	37	50*
c: Percentage of population rating health poor by Indigenous status and age		
	15-44 year olds	**45+ year olds**
Non-Indigenous	11	27
Indigenous – non-remote	21*	52*
Indigenous - remote	17*	39*

i. Note all descriptive statistics have been undertaken on age standardised data, with the exception of age cross-tabulations.

ii. * - significantly different from Non-Indigenous proportion at the 1% level using Fishers exact test[12].

The second finding from Table 2 is that older people are more likely to report poor health compared to younger people (27% of non-Indigenous people aged 45+ rate their health as poor, compared to 11% of 15-44 year olds). This holds across all the groups investigated in

[12] Note sample size for Fisher tests are based on the actual sample sizes where age standardised data are presented.

Table 2. The third panel of Table 2 also shows that, across age groups and the remoteness indicator, non-Indigenous people are less likely than Indigenous people to rate their health as poor. This is significant at the 1% level. There is a large difference in the proportions of remote and non-remote Aborigines rating their health as poor, and especially so for the older non-remote Aborigines. Of this group, 52% of those aged 45 or more rate their health as poor.

We next investigate how the health risk factors of body mass, smoking and drinking vary across population groups. Table 3 shows that the Indigenous population is more likely to drink, smoke and be underweight or overweight compared to the non-Indigenous population. In general, this holds across men and women, and across location. Fifty-five percent of male non-Indigenous are over-weight compared to 63% of Indigenous males living in non-remote areas. Notice that there is a relatively lower rate of obesity amongst Indigenous males living in remote areas, although this difference is not statistically significant. Some 39% of female non-Indigenous are over-weight compared to 56% of Indigenous females.

Table 3: Prevalence of risk factors by Indigenous status[i]

	Males	Females
a: grade 2 or grade 3 obesity		
non-Indigenous	55	39
Indigenous – non-remote	63*	56*
Indigenous - remote	51	56*
b: grade 2 or grade 3 thinness		
non-Indigenous	0.5	1.5
Indigenous – non-remote	0.0*	1.7
Indigenous - remote	2.7*	3.9*
c: smoking		
non-Indigenous	27	21
Indigenous – non-remote	50*	49*
Indigenous - remote	67*	47*
d: high-risk drinking		
non-Indigenous	30	26
Indigenous – non-remote	33	24
Indigenous - remote	41*	27

i. see table 2 notes.

In Table 4, we report means of the more 'objective' self-reported health measures relating to actual conditions, in order to see if the health gap remains. In general, these frequencies support the finding that Indigenous Australians have worse health than other Australians. However, note that Aborigines and non-Aborigines have similar rates of cancer

and heart disease (for example the percentage of people suffering from heart disease ranges from 18% for non-Indigenous males to 25% for Indigenous females living in remote areas).

There are several caveats to bear in mind when interpreting these results. First, some groups suffering from these conditions might actually be less likely to be diagnosed. For example, if diagnosis rates for Aborigines are lower in remote than non-remote locations, these individuals might report lower self-assessed health but will not report diagnosed physical conditions. Second, some may be more likely to die from other causes before they reach the age from which they are vulnerable to these diseases. For example, Aborigines suffer from higher rates of accidental death and suicides (AIHW, 2004). This means that many will never attain the age at which they might be expected to suffer from conditions such as heart disease. In short, there could be a selectivity problem arising from the nature of our data –or indeed any cross-sectional data, which cannot by its nature examine survival rates – implying that Aboriginal morbidity is possibly under-estimated.

Table 4: Objective health measures by Indigenous status[i]

	Males	Females
a: cancer		
non-Indigenous	1.8	0.9
Indigenous – non-remote	1.1	1.6
Indigenous - remote	0.4*	0.6
b: heart disease		
non-Indigenous	18	21
Indigenous – non-remote	20	22
Indigenous - remote	18	25*
c: diabetes		
non-Indigenous	3	3
Indigenous – non-remote	8*	11*
Indigenous - remote	13*	16*
d: hospitalisation		
non-Indigenous	11	13
Indigenous – non-remote	20*	19*
Indigenous - remote	19*	23*
e: medical professional contact		
non-Indigenous	24	29
Indigenous – non-remote	22	32*
Indigenous - remote	20	29
f: days outside of role		
non-Indigenous	14	17
Indigenous – non-remote	19*	20
Indigenous - remote	n.a.	n.a.

i. see table 2 notes.

It is well-known that Aborigines report higher rates of diabetes than non-Aborigines. Our data show that diabetes rates are 3% for non- Indigenous, but for Aborigines range from 8%

for men living in non-remote areas to 16% for women living in remote areas. The difference in rates of diabetes between Aborigines and non-Indigenous Australians is significant at the 1% level for all the sub-groups examined.

As well as high rates of diabetes, the Indigenous population has high rates of suicide (see AIHW, 2004).[13] Although we cannot deal here with cause of death, we can examine how the incidence of mental health varies by Aboriginal status. The raw data (not reported in Tables 2-4) show that non-remote Aborigines are more likely to report the following conditions compared to non-Aborigines: depression (9.2% compared to 5.9%), drug and alcohol dependency (3.3% compared to 0.9%) and anxiety (6.9% compared to 5.4%). It is striking that Aborigines living in remote areas are *less* likely to report these conditions than non-Aborigines, although we would not wish to make much of this owing to very small cell sizes for some of these measures.

Next we consider rates of hospitalisation over the past year, reported in Table 4. Aborigines are more likely to have been hospitalised than non-Aborigines: 11% of non-Indigenous males and 13% of non-Indigenous females have been hospitalised over the past year, compared to between 19% and 23% of the Indigenous population (hospitalisation rates are statistically significantly different between the Indigenous and non-Indigenous populations). Interestingly, there is little relationship between visiting a GP, specialist or dentist and Aboriginal status. Women in general are more likely to visit these health professionals than men. We also see limited differences between groups in terms of whether they had time out of their role in the last 2 weeks, with Indigenous people slightly more likely to have had times out of their role due to illness, where time out of role is defined as whether had days out of work or school due to own illness or had "other days of reduced activity".

One explanation for the health gap between Indigenous and other Australians is that the former have significantly lower socio-economic status, and that their worse health outcomes work through this mechanism. Table 5 reports three measures of socio-economic status – highest level of schooling, income, and employment status- disaggregated by Indigenous status. Some 13% of non-Indigenous people left school at year 8 or earlier, compared to 37% of Indigenous males and 31% of Indigenous females living in non-remote areas. In addition, 57% of non-Indigenous males and 77% of non-Indigenous females have an income

[13] There are a variety of issues with the reporting of suicide rates of the Indigenous population. However, AIHW (2004) report: "Death rates from suicide for Indigenous males and females are over twice the rate for non-Indigenous males and almost twice the rate for non-Indigenous females."

of less than $500 per week compared to 89% of Indigenous males and 91% of Indigenous females living in remote areas. Finally, 45% and 57% of non-Indigenous males and females respectively are not in employment, compared to 59% and 72% for Indigenous males and females respectively living in non-remote areas.[14] Thus, on all these measures of socio-economic status, Aborigines are faring worse than the rest of the population and these differences are all significant at the 1% level.[15] We investigate these differences further below as a possible explanation for the health gap.

Table 5: Socio-economic status measures by Indigenous status[i]

	Males	Females
a: year 8 schooling or lower		
non-Indigenous	13	13
Indigenous – non-remote	37*	31*
Indigenous - remote	45*	50*
b: income less than $500 per week		
non-Indigenous	57	77
Indigenous – non-remote	67*	65*
Indigenous - remote	89*	91*
c: not in employment		
non-Indigenous	45	57
Indigenous – non-remote	59*	72*
Indigenous - remote	52*	72*

i. see table 2 notes.

In summary the cross-tabulations reported in this section showed that the Indigenous population is more likely to report poor health and more likely to report low income, no educational qualifications and to be out of work. We next examine whether the difference in health status by Indigenous status could potentially be being driven by differences in socio-economic status (SES).

[14] The means for all Australians are as follows: Conditional on being over 15 years, 57% of the population is employed, 52% have income of less then $500 per week, 19% work less than 35 hours per week, 34% have as their primary source of income Government transfers and 14% have not completed year 8 schooling.

[15] Not surprisingly our socio-economic status variables are highly correlated, as shown in Appendix 1. In particular, there are high correlations between qualifications and main income source (people with low qualifications are more likely to receive Government transfers), hours of work and income (people working more hours per week have higher income), and qualifications and income (people with higher qualifications have higher income).

4. The Estimates

4.1 Does socio-economic status explain the health gap?

In this section we report results from a number of specifications of a simple ordered logit model, with the dependent variable y_i being a categorical measure of self assessed health (with 1 referring to health as poor and 5 referring to health as excellent).

With the simple ordered logit model we assume that there is one underlying latent variable y_i*, which relates to the observed dependent variable y_i as follows:

$$y_i^* = x_i'\beta + \varepsilon_i \quad (1)$$

$$y_i = j \quad \text{if} \quad \gamma_{j-1} < y_i^* \leq \gamma_j \quad (2)$$

Thus the probability that the observed dependent variable equals *j* is the probability that the latent variable y_i* is between the boundaries γ_{j-1} and γ_j (where the γs are unknown parameters that are estimated jointly with β).

For the ordered logit model, we assume that ε_i conforms to the logistic distribution. Maximum likelihood estimation is used and β is interpreted in terms of the underlying latent variable. A positive β coefficient to a particular variable implies that the latent variable, y_i*, increases as x_i increases. Thus, with a positive β, as x_i increases the probability that the observed dependent variable will take a value of 5 ('excellent' health) will increase, while the probability that the observed dependent variable will take a value of 1 ('poor' health). will decrease. [16]

In Table 6a we report estimates from a number of specifications of this simple ordered logit model. Specification [1] has, as explanatory variables, a small range of demographic variables – age, sex, marital status and Aboriginal status by remoteness. Indigenous status by *main language spoken at home* was also investigated, to examine whether speaking an Indigenous language at home had a separate effect on self-reported health. However, main language spoken at home was not significant, possibly partly because of the high correlation between remoteness and language spoken at home (for the Indigenous population the correlation between these variables is 0.57).

Specification [2] includes as additional variables our measures of socio-economic status. Our purpose here is to ascertain the extent of the health gap that might be attributable to differences in income, education and employment. Specification [3] augments our second specification by including a range of health risk variables and objective health measures. Here our goal is to investigate the extent of self-reported health that can be attributable to

[16] See Greene (2003) for a detailed discussion of ordered logit models.

different health conditions. If it is the case that not all health conditions may have been diagnosed, or if diagnosis rates differ across Indigenous/non-Indigenous status, we might expect that some of our demographic variables remain significant.

Table 6a: The determinants of self assessed health

	Specification [1] Simple	Specification [2] SES	Specification [3] Health (no interactions)	Specification [4] Health (with interactions)
Indigenous				
non-remote Indigenous	-0.73**	-0.40**	-0.17**	-0.01
(standard error)	(0.054)	(0.056)	(0.057)	(0.203)
remote Indigenous	-0.80**	-0.34**	-0.81**	-0.97**
(standard error)	(0.062)	(0.065)	(0.078)	(0.170)
Demographics				
25-44 year olds	-0.47**	-0.12*	0.03	0.03
45-69 year olds	-1.07**	-0.50**	-0.13*	-0.12*
70+ year olds	-1.59**	-0.49**	-0.02	-0.02
Female	0.04	0.22**	0.32**	0.32**
married/cohabiting	0.21**	0.18**	0.17**	0.17**
SES controls	No	Yes	Yes	Yes
Objective health measures	No	No	Yes	Yes
Health interactions	No	No	No	Yes
No. of observations	21020	21020	21020	21020
Log likelihood	-30065.1	-29433.4	-27743.7	-27710.9
Pseudo R^2	0.07	0.12	0.23	0.23
Wald test (Prob > chi2)	1553.9 (<0.001)	2747.8 (<0.001)	5645.6 (<0.001)	5696.1 (<0.001)

* significant at the 5% level, ** significant at the 1% level. Standard errors available for all coefficients on request.
Dependent variable is self assessed health, ranging from poor health (1) to excellent health (5). Positive coefficients refer to increased probability of reporting better health. See Appendix 2 for the coefficients of the socio-economic controls and objective health measures included.
Base category - 15-24 years, male, unmarried (social), non-Indigenous, employed, $1000-$1399 per week, work 35-48 hours per week, income source wage and salary, year 12 qualifications, normal range body mass index, non-smoker, not at-risk drinker, not admitted to hospital over the past year, exercised vigorously, no time away from role because of injury, not visited medical professional in past 2 weeks, not currently suffering from cancer, heart disease or diabetes.
All health variables were interacted with the Indigenous variables in interactions estimation.

First we consider the estimates for Specification [1] in Table 6a. The three age dummies are significantly negative (the base is 15-24 year olds) and the magnitude is larger for older groups who are more likely to experience worse health outcomes. Being married is statistically significant and is associated with better health. There is no gender effect in the simple demographic model. Finally, we find that the non-remote Indigenous and remote Indigenous (the base category is not Indigenous) coefficients are significant: being Indigenous is associated with poorer health. Note that the coefficient on the remote

Indigenous dummy is slightly larger, so that these individuals in this group report worse health outcomes.

We also calculated the marginal effects using the odds ratios, which are as follows. *Non-remote* Aborigines are 52% less likely than non-Aborigines to be in better health category (i.e. roughly speaking more likely to be 'good' as opposed to 'fair' for example). *Remote* Aborigines are 55% less likely to be in a better health category. Comparing these results to the impact of age, we see that being 25-44 years (as opposed to 15-24 years) is associated with a 38% decrease in the probability of being in a better health category, being 45-69 years is associated with a 66% decrease in probability, and being 70 years or more is associated with a 80% decrease in probability of being in a better health category.

In Specification [2] we estimate how much of the health gap is attributable to socio-economic variables. These are employment status, income, hours of work, source of income and qualifications.[17] We report estimated coefficients for the socio-economic variables in Appendix 2, and briefly comment on their impact later in this sub-section. The inclusion of the socio-economic variables leads to a reduction in the magnitude of the Aboriginal status coefficients. The coefficient on *non-remote* Indigenous status falls in absolute terms from from -0.73 to -0.40 and the coefficient on *remote* Indigenous status changes from -0.80 to -0.34. Both coefficients remain significant at the 1% level of significance.[18] Thus the inclusion of these variables has led to an approximate halving of the negative effect of Indigenous status. This suggests that, while socio-economic status is important in explaining variations in health, there are also other factors at work. We investigate some of these in the next sub-section.

Converting the impact of Indigenous status into marginal effects (again using odds ratios), we see that the lower probability for *non-remote* Indigenous of being in a better health category compared to non-Indigenous people falls from 52% to 33%, and for *remote* Indigenous the lower probability of being in a better health category falls from 55% to 29%.

[17] Our income measure is personal gross disposable income. We also experimented with using household equivalised income. The only substantive change in the results was that, while high personal income was associated with lower health status, high household income was associated with better health. Notice also that we cannot adjust our income measure for differences in prices across Australia, since we are unable to use the geographical variables owing to issues of confidentiality. All of our analyses had to be undertaken using the Remote Access Data Laboratory at the Australian Bureau of Statistics, and the package we used was SAS..

[18] To examine whether the impact of socio-economic characteristics differed between the Indigenous and non-Indigenous, interactions between Indigenous status and socio-economic status were included in the estimation. Since none of the interactions were significant at the 1% level, they were not included in the final estimations presented here. However note that, at the 5% level of significance, the interaction between remote Indigenous status and "main source of income: government transfers" was negative (indicating a smaller negative impact on health for remote Indigenous people).

This highlights the large difference that SES plays in explaining the health differences across demographic groups. A long term policy response to improve the health position of Aborigines might be to improve educational opportunities, allowing them greater access to the resources delivering better health (such as income and employment).

Next, consider the impact of the other demographic variables. The inclusion of the socio-economic variables is associated with a drop in size of the age coefficients, while the female coefficient becomes positive and significant (i.e. women are more likely to report higher health status, for a given level of SES) and the co-efficient on being married remains of a similar size. It is likely that the fall in significance of the age variables arises because older people are more likely to work shorter hours, receive Government transfers and have fewer qualifications.[19]

Finally, we briefly comment on the socio-economic effects, reported in Appendix 2. In general, the coefficients take the expected sign. Employment status is not significant. Lower income is associated with lower health, although income above A$1400 is also associated with lower health status (the base is $1000 to $1399 per week). Working fewer than 15 hours per week and receiving Government transfers is associated with lower health (possibly because people with worse health are more likely to work short hours and receive Government transfers). Individuals with fewer years of completed schooling have lower ratings of health.

With regard to the goodness of fit of our models, note that all the coefficients take the expected sign. We have quite a large sample size of 21,020 observations and there has been an over-sampling of the Indigenous population. In all specifications, the Wald test that all coefficients are equal to zero is rejected at the 0.1% level. The Pseudo R^2 in the simple demographic model is 0.07 and when socio-economic status variables are included the Pseudo R^2 increases to 0.12.[20]

4.2. Do risk factors and diagnosed health conditions affect the health gap?

We now include a range of health risk variables and objective health measures to examine the relationship between health status, Indigenous status, SES and other health measures

[19] The correlation between 70 years+ and short working hours is 0.07, between 70 years+ and receipt of Government transfers is 0.31, and between 70 years+ and no post school qualifications is 0.33.

[20] A potential concern is that Indigenous status and socio-economic status variables may be highly collinear. However, we found that all correlations are below 0.15. The variable pairs with correlations higher than 0.1 are: Indigenous status and "main source of income government transfers", and remote Indigenous status and working 16-34 hours per week and year 8 or below schooling. Variable pairs with correlations less then –0.1 are Indigenous status and year 12 schooling.

(see Table 6a). Sibthorpe *et al* (2001), using earlier Australian data, found that self-reported health is correlated with health problems for Indigenous Australians whose primary language is English. We investigate this issue in our estimation below. If the risk and diagnosed health measures introduced in Specification [3] captured all the information used by people to rank their health, then either all other variables would become insignificant or they would simply reflect reporting bias across groups. However, it is clearly impossible to include all the information that people use to rank their health, some of which is likely to be unobservable. Thus we expect some of our demographic variables to remain significant.

Appendix 3 shows that 43% of respondents are overweight or obese and 4% are underweight, 24% smoke, 26% are high risk drinkers, 81% have done no vigorous exercise over the past 2 weeks, 17% have spent time out of their role (working or studying) in the last 4 weeks due to ill-health, and 25% of people report some current heart or circulatory problem.

The health variables we include in Specification [3] are body mass index (bmi), smoking status, drinking status, hospitalisation over the past year, medical professional contact dummies, whether or not the person has spent time outside of their usual role, and a dummy for whether or not the person has cancer, diabetes or heart disease. The estimates of the Indigenous and demographic variables are reported in Table 6a, with extended results reported in Appendix 2. All the health variables take the expected sign, with the exception of drinking status, which is statistically insignificant.[21]

We first consider how including the health measures affects the coefficients on Aboriginal status by location. The coefficient on *non-remote* Indigenous halves in absolute magnitude from -0.40 to -0.17 – suggesting that, once we hold constant a number of objective health measures, non-remote Indigenous self-reported health improves relative to non-Indigenous health (i.e. their lower reported health is driven by lower actual health). Interestingly, the coefficient on *remote* Indigenous actually increases in absolute terms from -0.34 to -0.81.[22] This suggests that remote Indigenous are less likely to be diagnosed with health conditions, or visit health professionals given their health status (i.e. remote Indigenous people are less likely either to visit health professionals, report health risk

[21] Because of the nature of the drinking and smoking measures and their possible sensitivity to data collection methods (e.g. the presence of an interpreter or household member), caution should be exercised in interpreting their impact.

[22] The increase in the coefficient on remote Indigenous suggests that their health characteristics are more positive than those for non-Indigenous people (because when they are held constant the coefficient increases).

behaviour or report disease).[23] This result perhaps provides confirmation that remote Indigenous people have limited access to health services. On the other hand, the result may suggest that remote Indigenous people are more likely to report lower health status for a given level of health.[24]

Now consider the impact of other demographic variables. The inclusion of the 'objective' health variables lowers the coefficients on age - the coefficients on the 25-44 year old and 70+ dummies become insignificant while the dummy on 45-69 year olds becomes smaller, but remains significant. This suggests that the health variables included explain most of the remaining variation in health status by age. We see little change in the significance of the marriage variable, but the coefficient on female becomes larger and indicates that, holding constant health characteristics as well as SES, women are more likely to rate their health more positively than men. This suggests either that ceteris paribus women are healthier, or that there is some form of reporting bias (i.e. for a given level of health women report more positively).[25]

4.3 Does the impact of diagnosed health on self-assessed health vary with Indigenous status?

We next examine whether or not Indigenous people report a different relationship between health measures and self-reported health, and if this affects the coefficients on remote and non-remote Indigenous status. Table 6a reports the estimates of Specification [4], in which we interacted Indigenous status with all the health variables.[26] In the interests of space, we

[23] Two reasons for the positive coefficient on remote Indigenous (i.e. poorer health) are as follows. First, for a given level of health, they are less likely to be diagnosed (potentially because of limited access to health services). Thus poorer health is reflected in lower self-rated health, but not in increased diagnosis of conditions. Alternatively, the difference could be driven by the fact that the remote Indigenous population rates their health poorer for a given level of 'objective' health.

[24] As well as including all the objective health measures at one point in time, we also included the risk factors of health (smoking, drinking, BMI) separately from health conditions (cancer, heart disease, diabetes, medical contact etc). We find that risk factors explain most of the fall in the 25-44 year old coefficient (when all health conditions are included), while the health conditions explain most of the fall in the coefficients of the older age groups. While on the Indigenous coefficients, the risk factors explain about 2/3rd of the difference in coefficients between the SES and extended estimates, with conditions explaining the remaining 1/3rd of the difference.

[25] Women could be more likely to visit GPs and specialists (see section 4), and therefore more likely to be well-diagnosed, and consequently likely to have more reported health conditions for a given overall level of health. This could mean that men have the same level of health overall, but have lower awareness of problems. Thus the negative impact of being 'male' on health is because of under-reporting of a factor lowering reported health.

[26] In addition to including interaction terms between health status and Indigenous, we also estimated separate equations for the Indigenous population and the non-Indigenous population. The results are consistent with the results presented in this section. The health variables that were significantly different between equations were diabetes, visiting a dentist or nurse in the past 2 weeks, and being a high risk drinker.

do not report all interaction coefficients. The estimated coefficients of the included health variables for non-Indigenous people take the expected sign, again with the exception of drinking status (which is small in size). The signs of the coefficients for the age dummies, gender dummy and married dummy are similar to those presented in the non-interacted specification in column 2.

Inspection of Specification [4] shows that, when we include the interactions between Indigenous status and health measures, the coefficient for *non-remote* Aborigines shrinks in size and becomes insignificant. This suggests that the health gap between non-remote Indigenous and non-Indigenous people, holding health constant, is primarily driven by differences in the relationship between health measures and self assessed health. However, the coefficient on *remote* Aboriginal status actually increases in size.

Although we do not report all the estimated coefficients from the interactions (they are available from the authors on request), we briefly summarise some of the more interesting findings. First, the impact of body mass index is not significantly different across Indigenous status; neither are vigorous exercise, time outside of role due to injury, heart disease, cancer or diabetes variables. Second, the health variables that have a different effect on self-assessed health by Indigenous status are smoking, and visiting a doctor or dentist in the past 2 weeks. Interestingly, when we interact the high risk alcohol dummy with Indigenous status, the coefficient on the alcohol dummy becomes positive and significant, suggesting that non-Indigenous people who are heavy drinkers are more likely to report better health. However, the coefficient on the interaction between alcohol and Indigenous status becomes negative, suggesting Indigenous people who are heavy drinkers are more likely to report lower health status than non-Indigenous heavy drinkers, although these interactions are not significant for either non-remote or remote Indigenous people.

The association between visiting a doctor or dentist in the past 2 weeks and better health status for the remote Aborigines compared to the non-Aborigines is likely to reflect selection. Remote Aborigines visiting these health professionals are perhaps more likely to have higher income (so they can afford to visit) and more likely to have access to these services compared to their peers. Thus, it could be argued that for the remote Indigenous population that not only does seeing these health professionals indicate something about their health; it also indicates something about the resources available to them (which then independently affects health). It is possible that some of the remote communities are better serviced, perhaps by peripatetic health service professionals, an hypothesis that we are unfortunately unable to address, owing to the non-release of geographical data by the ABS.

4.4. Is mental health important in explaining the self-assessed health gap?

The issue of Indigenous mental health is important because of the high rates of suicide and mental health problems amongst the Indigenous population. Specification [5] augments Specification [3] by the inclusion of mental health conditions. These were not included in the main specifications, because of our concern that they might suffer from reporting issues, since they are not necessarily based on clinical assessment.

Table 6b: Estimation with mental health disorders

	Specification [5] without interactions	Specification [6] with interactions
Indigenous		
non-remote indigenous	-0.16**	-0.02
(standard error)	(0.057)	(0.204)
remote indigenous	-0.90**	-1.02**
(standard error)	(0.078)	(0.170)
Demographics		
25-44 year olds	0.05	0.05
45-69 year olds	-0.12*	-0.12*
70+ year olds	-0.11	-0.10
Female	0.32**	0.32**
married/cohabiting	0.13**	0.12**
Mental health variables		
depression	-0.58**	-0.62**
Anxiety	-0.53**	-0.53**
other mental disorder	-0.64**	-0.64**
alcohol and drug dependency	-0.60**	-0.62**
urb_indigen*doctor		-0.34*
urb_indigen*depression		0.53*
rem_indigen*doctor		0.36*
rem_indigen*dentist		0.51*
Objective health controls	Yes	Yes
Socio-economic Status controls	Yes	Yes
Interactions between all health variables and indigeneity	No	Yes
Number of observations	21020	21020
Loglikelihood	-27544.3	-27702.6
Pseudo R^2	0.24	0.23
Wald test (Prob > chi2)	5938.2 (<0.001)	5710.5 (<0.001)

* significant at the 5% level, ** significant at the 1% level. Standard errors available on request.
Dependent variable is self assessed health, ranging from poor health (1) to excellent health (5). Positive coefficients on all estimations refer to increased probability of reporting poorer health.
Base category - 15-24 years, male, unmarried (social), non-Indigenous, employed, $1000-$1399 per week, work 35-48 hours per week, income source wage and salary, year 12 qualifications, normal range body mass index, non-smoker, not at-risk drinker, not admitted to hospital over the past year, exercised vigorously, no time away from role because of injury, not visited medical professional in past 2 weeks, not currently suffering from cancer, heart disease, diabetes or a mental illness. Only significant interaction variables are shown.

Specification [5] estimates are reported in the first column of Table 6b. Mental health conditions such as depression, anxiety, alcohol and drug dependency are associated with significantly worse self-assessed health. The main effects of the inclusion of the mental health disorders in addition to the other health conditions of Specification [3] are first, that the coefficient on 70+ years increases in absolute terms although it remains insignificant. Second, the statistically significant coefficient on remote Indigenous also increases in absolute terms. These results highlight that - holding other characteristics constant - these two groups are less likely to report mental health disorders.

In Specification [6] – reported in the last column of Table 6b - we also include mental health variables interacted with Aboriginal status. We do not report the full set of coefficients but note that non-Aborigines who have a long-term mental health condition are significantly more likely to report worse health. The only mental health interaction that is significant at the 5% level is the interaction between non-remote Indigenous status and depression – highlighting that the impact of depression on health for the non-remote Indigenous is smaller than that for the non-Indigenous.

4.5. How well-specified are the results?

In the specifications with health explanatory variables included, again our coefficients take the expected sign, with poor health conditions being associated with lower self-rated health. The Wald joint test that all coefficients are equal to zero is rejected at the 0.1% level of significance. The Pseudo R^2 increases from 0.12 with the demographic variables included, and to 0.23 when the health variables are added. When the interactions between health variables and Indigenous status are also included, the Pseudo R^2 remains at 0.23.

5. Checking robustness

In the previous section, we showed that there was a difference between Indigenous and non-Indigenous reported health status and that this was partly explained by differences in socio-economic status between groups. We also showed that the relationship between self reported health on the one hand, and health conditions and risk factors on the other hand, varied with Indigenous and non-Indigenous status. In this section we investigate the sensitivity of the results to alternative modelling assumptions.

5.1 Are the results sensitive to the ordered logit estimation?

One of our assumptions was of a continuous latent variable underlying the ordering of the self-assessed health dependent variable. However, it is possible that people rate the difference in health between 'very good' and 'excellent' quite unlike the difference between 'fair' and 'good', as suggested by Manderbacka et al., 1998. If this is the case, our results might be sensitive to the ordered logit approach. To investigate this, we compare the ordered logit results to a simple OLS and to binary logit estimation (where the dependent variable takes a value of 1 if self assessed health is 'good', 'very good' or 'excellent', and 0 otherwise). The results of this are reported in Tables 7a and 7b.

Table 7a: Binary Logit results

	Specification [7] Binary - simple	Specification [8] Binary - SES	Specification [9] Binary - Health
Indigenous			
non-remote Indigenous	-0.83**	-0.42**	-0.17*
(standard error)	(0.070)	(0.074)	(0.082)
remote Indigenous	-0.55**	-0.04	-0.59**
(standard error)	(0.085)	(0.092)	(0.129)
Demographics			
25-44 year olds	-0.61**	-0.34**	-0.18*
45-69 year olds	-1.42**	-0.86**	-0.49**
70+ year olds	-1.88**	-0.74**	-0.31**
Female	0.02	0.26**	0.37**
married/cohabiting	0.34**	0.27**	0.23**
SES controls included	No	Yes	Yes
Health measures included	No	No	Yes
Observations	21020	21020	21020
Loglikelihood	-9785.3	-9334.9	-8283.0
Pseudo R^2	0.05	0.09	0.17
Wald test (Prob > chi2)	1112.1 (<0.001)	1868.9 (<0.001)	3111.0 (<0.001)

* significant at the 5% level, ** significant at the 1% level. Standard errors for all coefficients available on request.
Dependent variable =1 if health reported as not "fair" or "poor" and =0 otherwise. Positive coefficients on all estimations refer to increased probability of reporting better health
Base category - 15-24 years, male, unmarried (social), non-Indigenous
SES and health coefficients are available from authors on request.

Table 7a presents the results from a binary logit, where the dependent variable takes a value of 1 if health status is "good", "very good" or "excellent" and 0 otherwise. Table 7b presents the results from anOLS estimation where the health variable is treated as a continuous variable. In all cases the signs and level of significance agree across all three

estimations when only demographic variables are included (binary logit, OLS and ordered logit) – see specifications 7 and 10. In general the relative size of the coefficients also agree. That is the age coefficients tend to be largest, followed by the Indigenous status coefficients, and the marriage coefficients. The female dummy is insignificant in all three estimations.

When we include socio-economic status variables, as well as the demographic variables, the coefficients on Indigenous status fall in absolute terms in the binary logit and the OLS estimations. Surprisingly, when SES variables are included, the coefficient on remote Indigenous goes almost to zero in the binary logit. In the OLS, the binary logit and ordered logit specifications income (with the exception of high income earners), income source and educational qualifications take the expected sign.

Table 7b: OLS results

	Specification [10] OLS - simple	Specification [11] OLS - SES	Specification [12] OLS – health
Indigenous			
non-remote Indigenous	-0.42**	-0.22**	-0.07*
(standard error)	(0.032)	(0.031)	(0.029)
remote Indigenous	-0.47**	-0.20**	-0.42**
(standard error)	(0.036)	(0.037)	(0.040)
Demographics			
25-44 year olds	-0.28**	-0.08**	0.01
45-69 year olds	-0.64**	-0.30**	-0.08**
70+ year olds	-0.94**	-0.28**	-0.02
Female	0.03	0.12**	0.16**
married/cohabiting	0.13**	0.10**	0.08**
SES controls included	No	Yes	Yes
Health measures included	No	No	Yes
Observations	21020	21020	21020
R^2	0.08	0.13	0.26
F statistic (Prob > chi2)	244.6 (<0.001)	132.9 (<0.001)	171.0 (<0.001)

* significant at the 5% level, ** significant at the 1% level. Standard errors available on request.
Dependent variable is self assessed health, treated as a continuous variable.
Base category - 15-24 years, male, unmarried (social), non-Indigenous, employed, $1000-$1399 per week, work 35-48 hours per week, income source wage and salary, year 12 qualifications
F statistics is provided for the OLS results
SES and health coefficients are available from authors on request.

When we also include the health condition variables in estimation in specifications 9 and 12 the results are very consistent across estimation methods. When health variables are included, the coefficient on *non-remote* Indigenous falls (highlighting that non-remote

Indigenous appear to have more diagnosed health problems). In contrast, the coefficient on *remote* Indigenous increases (highlighting that the remote Indigenous population may be under-diagnosed or may consider the relationship between objective health and subjective health differently). Again, the sign and level of significance of the coefficients across the three estimation methods generally agree.

5.2 Are the results sensitive to the dependent health variable?

It could be argued that the results from Section 4 are sensitive to the choice of dependent variable used - the possibly subjective self-assessed measure of health. We therefore experimented with using a more 'objective' measure of health status. Table 8 compares the results from the ordered logit to two binary logits. In the first estimation the dependent variable is whether currently suffer from diabetes and in the second estimation the dependent variable is 'hospitalisation over the past year'.

Table 8: Sensitivity of result to SAH

	Specification [13] Diabetes (simple)	Specification [14] Diabetes (SES)	Specification [15] hospital (simple)	Specification [16] hospital (SES)
Indigenous				
non-remote Indigenous	1.49**	1.21**	0.61**	0.44**
(standard error)	(0.11)	(0.12)	(0.076)	(0.079)
remote Indigenous	2.02**	1.67**	0.72**	0.53**
(standard error)	(0.11)	(0.12)	(0.083)	(0.090)
Demographics				
25-44 year olds	1.29**	0.88**	0.23**	-0.03
45-69 year olds	2.92**	2.29**	0.26**	-0.14
70+ year olds	3.43**	2.34**	0.94**	0.20*
Female	-0.03	-0.19**	0.26**	0.12**
married/cohabiting	-0.05	0.04	0.11*	0.14**
dependent variable	diabetes	diabetes	hospitalisation	hospitalisation
controls for SES	no	yes	no	yes
controls for health status	no	no	no	no
No. of observations	21020	21020	21020	21020
Log likelihood	-3573.6	-3489.8	-8576.3	-8440.0
Pseudo R^2	0.05	0.05	0.02	0.03
Wald test (Prob > chi2)	799.7 (<0.001)	890.6 (<0.001)	340.6 (<0.001)	584.3 (<0.001)

* significant at the 5% level, ** significant at the 1% level. Standard errors available on request.
The dependent variable in specifications 13 and 14 =1 if currently suffer from diabetes and =0 otherwise.
The dependent variable in specifications 15 and 16 =1 if hospitalised over the past year and =0 otherwise.
Base category - 15-24 years, male, unmarried (social), non-Indigenous

Table 8 shows that our earlier finding - that differences in socio-economic status partly explain the gap between Indigenous and non-Indigenous health - is not sensitive to the choice of the dependent variable. In the self-assessed health estimation, when we control for SES the coefficients on non-remote Indigenous and remote Indigenous fell by approximately one half (from -0.73 to -0.40 and from -0.80 to -0.34). Table 8 shows, in the hospitalisation and diabetes estimations - specifications [13] to [16] - that the coefficient on the Indigenous variables falls by between one fifth and one third when we include SES variables. In the diabetes estimation the coefficient on non-remote Indigenous falls from 1.49 to and 1.21 and the coefficient on remote Indigenous falls from 2.02 to 1.67. In the hospitalisation estimation the coefficient falls from 0.61 to 0.44 for non-remote Indigenous and 0.72 to 0.53 for remote Indigenous.

We now turn to a comparison of the size of the marginal effects in the hospitalisation estimation using the odds ratios. Without SES controls, non-remote Indigenous are 85% more likely to be hospitalised than non-Indigenous, while remote Indigenous are 105% more likely to be hospitalised. Where SES is controlled for, the probabilities fall to 55% for non-remote Indigenous and 70% for remote Indigenous. This is comparable to our results reported in Section 5 where the dependent variable was self assessed health. There we found that, with the addition of the SES controls, the probability of the non-remote Indigenous being in a worse health category than the non-Indigenous falls from 52% to 33%. For the remote Indigenous, the probability falls from 55% to 29%.

6. Conclusions

We have shown that there is a statistically significant gap in self-assessed health status between Indigenous and non-Indigenous Australians, and that socio-economic variables explain between one third and one half of the gap. This result is robust to alternative dependent variables and estimation methods.

We also showed that diagnosed health conditions explain some of the health gap between Indigenous and non-Indigenous Australians. When objective health measures (such as whether individuals currently have cancer, diabetes or heart disease) are included in estimation the coefficient on non-remote Indigenous is reduced. This result indicates that the non-remote Indigenous population has worse diagnosed health than the non-Indigenous population and that diagnosed health conditions and health risk behaviour explain some of the gap between Indigenous and non-Indigenous Australians. However, interestingly when we include objective health measures the coefficient on remote Indigenous increases. This

result suggests either that remote Aborigines either have fewer diagnosed conditions for a given level health (i.e. they have been under-diagnosed), or that the relationship between health conditions and self assessed health is different for the remote Aboriginal population.

Our results do not indicate causality, but only show the associations between variables. Several of the variables may suffer from endogeneity problems. For example, income source and whether or not the person undertook vigorous exercise are each potentially endogenous. In both cases causality is likely to run both ways - ill people are more likely to receive transfers and less likely to exercise, while well people who exercise and receive wage and salary income are more likely to be healthy. The investigation of this causality through panel data or instrumental variables is beyond the scope of this paper, but this potential endogeneity problem should be noted.

Several important policy issues emerge from our analysis. Because the observed health disparity is partly driven by differences in socio-economic status, policies directed at improving the socio-economic status of Aborigines will also be associated with an improvement in their health. On the other hand, even when controlling for socio-economic status, there remains a significant gap in health status between Aboriginal and non-Aboriginal Australians. This suggests either that the controls for socio-economic status do not entirely capture access to economic and social resources, or that there are additional factors at work. These could include cultural issues relating to health behaviour, the availability of health services to Indigenous Australians living in remote (and potentially non-remote) areas, and historical events that have led to differences in health behaviour across groups that are unrelated to socio-economic status. In our estimation we used a remarkably rich set of explanatory variables but nonetheless there remained a significance difference in health between the Aboriginal and non-Aboriginal groups. At least some of this unexplained component is likely to be attributable to differences in the delivery of health services.[27]

To minimize differences in health status it is important not only to address differences in socio-economic status but also to examine the disparities in access to health services and variations in health behaviour. However, further analysis is required to ascertain if the remaining difference in health status after controlling for socio-economic status is driven by access to health services (health supply driven), health behaviour (patient driven),

[27] We would like to have included dummy variables for state and territory of residence, since there is some heterogeneity in health policy across these jurisdictions. However the ABS was unwilling to allow us access to this information owing to issues of confidentiality.

environmental factors, or a combination of all of these. It would be advantageous if such analysis could be undertaken with panel data in order to establish the direction of the causality and to investigate issues of mortality differences that cannot be explored with the available data. The gap in health status between Indigenous and non-Indigenous Australians remains an important issue, if not a national disgrace.

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Appendix 1: Correlations between Variables [i, ii, iii, iv]

	employ	inc250	in1000	in1400	hr<15	hr<48	hr>49	s wage	s govt
income <250	-0.45	…							
income <1000	0.41	…	…						
income > 1400	0.12	…	…	…					
hrs per wk >15	0.26	0.15	-0.12	-0.01	…				
hrs per wk <48	0.52	-0.37	0.46	0.00	…	…			
hrs per wk >49	0.31	-0.21	0.10	0.20	…	…	…		
source wage	0.79	-0.43	0.43	0.06	0.05	0.55	0.22	…	
source govt	-0.64	0.61	-0.38	-0.13	-0.02	-0.41	-0.25	…	…
year 12 school	0.26	-0.19	0.14	0.09	-0.01	0.18	0.13	0.26	-0.24
≤year 8 school	-0.28	0.24	-0.14	-0.03	-0.06	-0.17	-0.09	-0.26	0.32

i. income <1000 is where a person has income between $500 and $1000

ii. hrs per wk <48 is where a person works between 35 and 48 hours per week

iii. employ is where a person is in employment in the reference week

iv. where the correlation is on the variable itself or on a related dummy variable the correlation has been suppressed.

Appendix 2: Socio-economic Status and Objective Health Measure results

	Specification [2] SES - extended	Specification [3] Health - extended
Indigenous controls		
non-remote Indigenous	-0.40**	-0.17**
remote Indigenous	-0.34**	-0.81**
Socio-economic status		
unemployed	0.18	0.04
Nlf	-0.08	-0.09
inc250	-0.28**	-0.28**
inc500	-0.21**	-0.18**
inc1000	-0.17**	-0.14*
inc1400	-0.13*	-0.15*
Incmiss	0.29	0.17
hr15	-0.03	-0.05
hr34	-0.04	-0.05
hr49	0.04	0.02
Hrmiss	-0.26	-0.17
source_govt	-0.43**	-0.29**
source_cash	0.10*	0.14**
source_miss	-0.43	-0.32
qual_miss	0.80**	-0.52
qual_9_11	-0.27**	-0.14**
qual_8	-0.65**	-0.50**
Objective health measures		
bmi_miss		-0.31**
bmi_thin1		-0.27**
bmi_thin2		-0.53**
bmi_obe1		-0.22**
bmi_obe2		-0.63**
Smoke		-0.49**
smoke_miss		0.04
high risk alcohol		0.05
alcohol miss		1.16
hospital in past yr		-0.41**
no vigorous exer.		-0.67**
Role		-0.84**
Cancer		-1.05**
Heart		-0.68**
Diabetes		-0.85**
Demographic dummies	yes	yes
Observations	21020	21020
Loglikelihood	-29433.4	-27743.7
Pseudo R^2	0.12	0.23
Wald test (Prob > chi2)	2747.8 (<0.001)	5645.6 (<0.001)

significant at the 5% level, ** significant at the 1% level. Standard errors available on request.
Base category - 15-24 years, male, unmarried, non-Indigenous, employed 35-48 hours per week, $1000-$1399 per week, year 12 qualifications. In addition, in the health estimation, the base category includes normal range body mass index, non-smoker, not at-risk drinker, not admitted to hospital over the past year, exercised vigorously, no time away from role because of injury, not visited medical professional in past 2 weeks, not currently suffering from cancer, heart disease or diabetes. Explanatory variables have also been added in the health estimation to control for whether contacted medical professionals in past 2 weeks.

Appendix 3: Variable Descriptions and Means

Variable	Description	means
25-44 year olds	=1 if person aged 25-44 years, 0 otherwise	0.40
45-69 year olds	=1 if person aged 45-69 years, 0 otherwise	0.32
70+ year olds	=1 if person aged 70 years+, 0 otherwise	0.12
Female	=1 if female, 0 otherwise	0.54
married/cohabiting	=1 if living in the state of marriage, 0 otherwise	0.52
non-remote Indigenous	=1 if Aboriginal or Torres strait islander in non- remote area, 0 otherwise	0.06
remote Indigenous	=1 if Aboriginal or Torres strait islander in remote area, 0 otherwise	0.04
unemployed	=1 if unemployed, 0 otherwise (ILO definition)	0.04
nlf	=1 if not in the labour force, 0 otherwise	0.38
inc250	=1 if total gross weekly personal cash (tgwpc) income ≤ $250	0.32
inc500	=1 if tgwpc income ≤$500 and if tgwpc income >$250	0.20
inc1000	=1 if tgwpc income ≤$1000 and if tgwpc income >$500	0.25
inc1400	=1 if tgwpc income >$1399	0.11
incmiss	=1 if income missing	0.06
hr15	=1 if usual hours worked per week (uhwpw) ≤15	0.08
hr34	=1 if uhwpw ≤34 and uhwpw>15	0.11
hr49	=1 if uhwpw>48	0.12
hrmiss	=1 if hours per week missing	0.43
source_govt	=1 if main source of tgwpc income Government pension or allowance	0.34
source_cash	=1 if main source of tgwpc income other cash income	0.14
source_miss	=1 if main source of tgwpc income missing/unknown/not applicable	0.06
qual_miss	=1 if school qualifications not applicable or not stated	0.07
qual_9_11	=1 if last completed year of schooling between year 9 and year 11	0.45
qual_8	=1 if last completed year of schooling between year 8 or lower	0.14
bmi_miss	=1 if body mass index not provided	0.11
bmi_thin1	=1 if grade 1 thinness	0.03
bmi_thin2	=1 if grades 2,3 thinness	0.01
bmi_obe1	=1 if grade 1 overweight	0.28
bmi_obe2	=1 if grades 2,3 obesity	0.15
smoke	=1 if current daily regular smoker	0.24
smoke_miss	=1 if smoking status not available or not applicable	0.07
high risk alcohol	=1 if risky or high risk alcohol consumer	0.26
alcohol miss	=1 if alcohol missing	0.07
hospital in past yr	=1 if hospitalised in last 12 months	0.15
no vigorous exer.	=1 if did not do vigorous exercise in past 2 weeks	0.81
role	=1 if in past 2 weeks had days lost from school/work/days of reduced activity	0.17
hospit_2w	=1 if in past 2 weeks had contact with hospital inpatient/casualty/emergency/ outpatient	0.04
doct_2w	=1 if in past 2 weeks visited General Practitioner or Specialist	0.27
dent_2w	=1 if visited dentist	0.06
nurse_2w	=1 if visited Aboriginal health work/ nurse/ social worker/welfare officer	0.03
other_2w	=1 if visited other health professional	0.15
cancer	=1 if currently have cancer	0.02
heart	=1 if currently have heart of circulatory conditions	0.25
diabetes	=1 if currently have diabetes	0.05
poor	=1 if health reported as ‘fair’ or ‘poor’	0.20
hospitalisation	=1 if hospitalised in past year	0.15
self-assessed health	=1 if health ‘poor’, 2 if ‘fair’, 3 if ‘good’, 4 if ‘very good, 5 if ‘excellent’.	2.57