THE UNIVERSITY OF MELBOURNE

Families, Incomes and Jobs, Volume 4

A Statistical Report on Waves 1 to 6 of the HILDA Survey

MELBOURNE INSTITUTE of Applied Economic and Social Research

The HILDA Survey is funded by the Australian Government Department of Families, Housing, Community Services and Indigenous Affairs

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33. Socio-economic correlates of body size among Australian adults

Michael Kortt[†] *and Andrew Leigh*[‡]

Introduction

The sixth wave of the HILDA Survey contains, for the first time, information on the height and weight of each respondent. Although HILDA is not the first Australian survey to ask these questions, it contains considerably more information about respondents' socio-economic characteristics than the past health surveys which have included these questions.

In this article, we describe the socio-economic correlates of height and weight in Australia. Our primary focus is on factors that are likely to affect body size. In a companion paper (Kortt and Leigh, 2008), we look at the relationship between body size and wages. We discuss the findings of that paper in our conclusion.

Measuring body size

As measures of body size, we use respondents' self-reported height (in centimetres) and the body mass index or BMI (which is defined as weight in kilograms divided by height in meters squared).[1] To account for the possibility that the relationship between BMI and other socio-economic characteristics may be nonlinear, we look at BMI both as a continuous variable, and as a categorical variable. For the categorical measure of BMI, the commonly-used variables are underweight (BMI<18.5), normal-range BMI score (18.5≤BMI<25), overweight (25≤BMI<30), and obese (BMI?30). We restrict our sample to respondents aged 21 or over, an age at which most people have stopped growing taller.

Associations with body size

According to the HILDA data, the average height of Australian adults is 163cm (5 feet 4 inches) for women and 177cm (5 feet 10 inches) for men. The average BMI of women is 26 and the average BMI of men is 27. 29% of women are overweight, and 23% are obese. These proportions are even higher for men—42% of men are overweight, and 23% of men are obese. Our estimates are close to those from the most recent National Health Survey (NHS), conducted by the Australian Bureau of Statistics (2006). The 2004–05 NHS (based on self-reported data from adults 18 and over), found that the average height for women was 164cm and the average height of men was 178cm (ABS, 2006). The average BMI for women was 25, while the average BMI for men was 27. Statistics on overweight and obesity in the NHS also closely match our figures from HILDA, giving us some reassurance in the precision of our results.

We then focus on seven characteristics—region of residence, birth year, education, father's occupational status (when the respondent was aged about 14), marital status, whether the respondent was born overseas, and Indigenous status.[2] We chose these characteristics because we believe they are more likely to be determinants of body size than to be a function of body size. However, this may not be universally true. For example, while marital status may affect obesity, it might also be that obesity affects marital status—or, indeed, a third factor may affect both. In all cases, we present our results separately for women and men.

Body size by state and territory

We first compare height and BMI patterns across states and territories. For the six states, our sample size ranges from 1,316 men and 1,532 women in New South Wales, to 153 men and 169 women in Tasmania. However, the territory sample sizes are smaller, with just 89 men and 99 women in the Australian Capital Territory, and 30 men and 36 women in the Northern Territory. To take account of this issue, we run formal statistical tests for each state and territory, to evaluate whether their statistic is significantly different from the average for all other states and territories. We denote instances where the difference is significant at the 5% level by '#', and at the 1% level by '##'. Since we are testing so many hypotheses simultaneously, we do not report differences that are only significant at the 10% level. Although we only report the raw difference in the tables, we observe much the same patterns if we control for respondent age when estimating these tests.

Table 33.1 shows our results for women. On average, women in New South Wales are significantly shorter (162.6cm) than in other states, while women in South Australia (164.1cm) and Western Australia (164.1cm) are significantly taller than those in other states. In terms of BMI, women from South Australia have a significantly higher BMI (26.9) than women in other states, while women from the Northern Territory have a significantly lower average BMI (23.9). In terms of BMI categories, women from the Northern Territory are more likely to be underweight (9%) and less likely to be overweight (15%) than in other states and territories. Women from Victoria have a lower rate of obesity (20%) than other states, while women in Tasmania have a higher rate of obesity than other states (30%).

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Turning to men in Table 33.2, we observe fewer statistically significant differences in body size across states. Victorian men are significantly shorter (176.9cm) than men in other states, while Queensland men are significantly taller (177.8cm). In terms of men's average BMI and underweight, overweight and obesity percentages, we do not observe any statistically significant differences across Australian states and territories.

Body size by birth year

In Tables 33.3 and 33.4, we show height by birth cohort for men and women. We also present four scatter plots, illustrating the relationship between birth year and height/BMI for both men and women. These charts help to show not only the general pattern—as illustrated by the fitted line—but also the high degree of dispersion. While there is a discernable relationship between birth year and body size, this only explains a small portion of the overall variation in body size.

These data allow us to ask the question—are today's Australians taller than their predecessors?[3] Since our data are drawn from a single cross-section, we are unable to separate lifecycle effects (in which people's height falls over time) from cohort effects (in which health improvements lead to increases in average height). However, we can draw upon Sorkin et al. (1999), who use longitudinal data for a large sample of men and women in Baltimore over the period 1958–1993 to devise formulas for height loss over the lifecycle.[4] For example, their formulas suggest that from age 40 to age 60, women shrink in height by 3cm, while men shrink by 2cm. Assuming this finding applies to all Australians today, we can adjust the observed heights in the HILDA dataset, and give all respondents an 'age-adjusted' height. Even taking this into account, there appears to be a secular increase in heights. For both men and women, the heights of those born in 1976–85 (aged 21–30 at the time of the survey) are 3cm higher than those born in 1946–55 (aged 51–60 at the time of the survey). When we adjust each individual's height to take account of changes over the lifecycle, the birth year difference falls to 2cm for men (statistically significant at the 1% level), and 1cm for women (statistically significant at the 5% level).

We can also observe patterns of BMI by birth cohort. This suggests that for both women and men, there is an inverse-U relationship between birth year and BMI. BMI is lowest among the oldest and youngest cohorts in our data (born before 1935, or in 1976–85), and highest among those born in 1946–55. However, we should again be careful in interpreting this as a cohort effect, since we are drawing on a single cross-section. Unlike in the case of height, we are unable to make adjustment assumptions about the relationship between age and BMI, since this may differ across countries and time periods.

Table 33.1: Body size by state and territory—Women

State	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
New South Wales	162.6##	26.3	3	28	23
Victoria	162.9	26.1	3	31	20##
Queensland	163.5	26.4	4	27	24
South Australia	164.1#	26.9#	5	32	26
Western Australia	164.1##	26.4	3	32	22
Tasmania	163.0	27.3		23	30#
Northern Territory	164.4	23.9##	9#	15#	11
Australian Capital Territory	163.4	25.7	0	26	17
Total	163.2	26.3	3	29	23

Population weighted results. ## and # denote statistical significance from a test of the hypothesis that the state or territory's figure is statistically different from the average in other states and territories (## = 1% level, # = 5% level).

Table 33.2: Body size by state and territory—Men

State	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
New South Wales	177.2	27.1	1	41	24
Victoria	176.9#	26.8	1	41	21
Queensland	177.8#	27.1	1	43	23
South Australia	177.9	26.8	2	45	21
Western Australia	177.4	27.2	1	41	24
Tasmania	177.0	27.8	2	42	25
Northern Territory	179.3	27.5	0	52	25
Australian Capital Territory	177.8	27.2	0	40	26
Total	177.4	27.0	1	42	23

Notes: Population weighted results. # denotes statistical significance from a test of the hypothesis that the state or territory's figure is statistically different from the average in other states and territories (# = 5% level).

Table 33.3: Body size by birth year—Women

Birth year	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
1935 or earlier	160.3	26.3	4	38	20
1936–45	162.3	27.0	3	37	25
1946–55	162.3	27.7	2	31	31
1956–65	163.5	26.5	3	26	25
1966–75	164.1	26.2	2	25	21
1976–85	165.1	24.5	8	24	13
Total	163.2	26.3	3	29	23

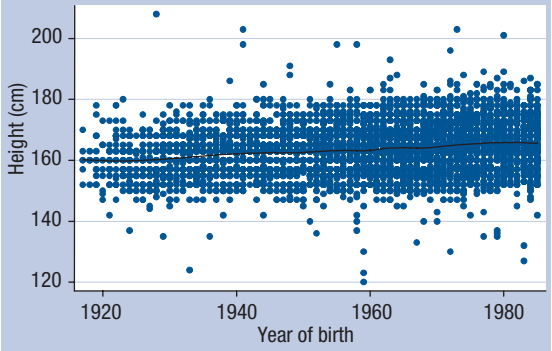
Note: Population weighted results.

Table 33.4: Body size by birth year—Men

Birth year	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
1935 or earlier	174.6	26.3	2	40	19
1936–45	175.3	27.6	1	46	26
1946–55	176.6	28.1	0	47	29
1956–65	177.4	27.6	1	44	27
1966–75	178.6	26.9	0	43	21
1976–85	179.8	25.4	1	32	14
Total	177.4	27.0	1	42	23

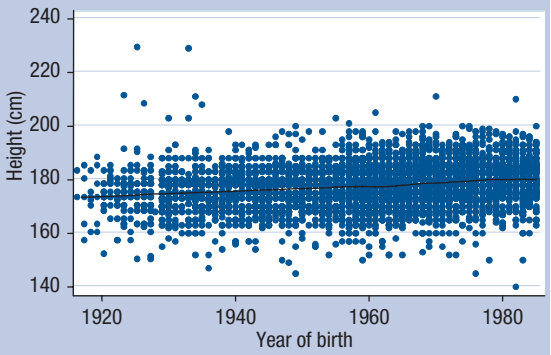
Note: Population weighted results.

Figure 33.1: Height by year of birth—Women



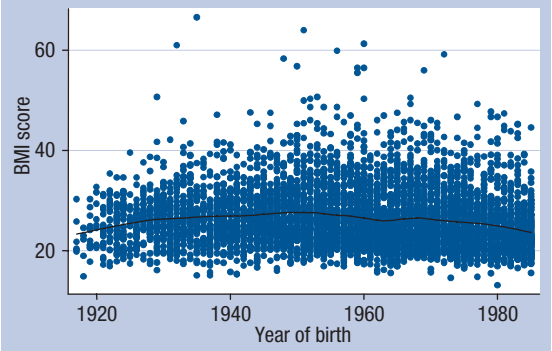
Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Figure 33.3: Height by year of birth—Men



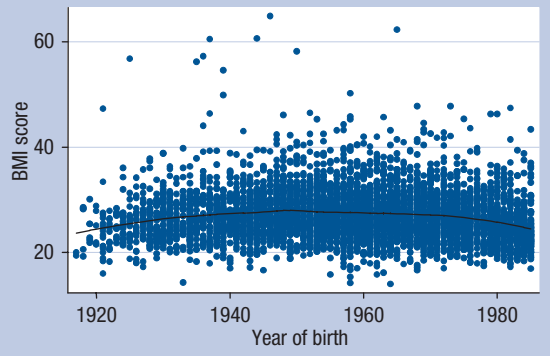
Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Figure 33.2: BMI by year of birth—Women



Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Figure 33.4: BMI by year of birth—Men



Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Body size by highest level of education

For women, there is a strong relationship between body size and highest level of education as shown in Table 33.5. University-educated women are 3 centimetres taller than women whose highest level of education is Year 11 or below. A similar relationship is also observed for average BMI. Only 13%of women with bachelor degrees are obese, followed by 17% of women with postgraduate qualifications. On the other hand, 28% of women who have only completed Year 11 or below are obese—these differences are statistically significant. This could potentially reflect the causal effect of education on health, but it is also possible that poor health makes it more difficult to gain further education, or that both health and education are affected by some third factor, such as an individual's rate of time preference (i.e. the value they place on wellbeing in the future as compared with wellbeing in the present).

The strong association between body size and highest level of education is also observed for men as shown in Table 33.6. The tallest men, on average, are those who have a bachelor's degree (178.4cm) or some type of postgraduate qualification (178.1cm). The shortest men (176.2cm) have only completed Year 11 and below. This relationship is also mirrored for average BMI. For instance, men with bachelor degrees, on average, have the lowest BMI (26.0)—approximately one unit lower than the national BMI average of 27.0. Moreover, only 15% of men with bachelor degrees are obese, closely followed by 16% of men with postgraduate qualifications. On the other hand, 30% of men who have only completed Year 11 and below are obese. Again, while the relationships are statistically significant, we caution readers not to necessarily draw causal conclusions from these associations, since the causal pathway could run in either direction, and possibly in neither direction.

Body size by respondent's father's occupational status

We also examined the correlation between body size and the respondent's father's occupational status. This occupational status indicator, which was developed by researchers at the Australian National University, rates the prestige of the father's occupation when the respondent was about age 14, ranging from 0 to 100, with a higher score corresponding to a more prestigious occupation. On average, women with a father in the top occupational status decile were 1cm taller than women with a father in the bottom occupational status decile. This positive relationship—which plateaus out at higher scores—is illustrated in Figure 33.5 below with height on the vertical axis and father's occupational status on the horizontal axis.

For men, a similar relationship is also observed in Figure 33.6, with sons of men in the top occupational decile being 1cm higher than sons of men in the bottom occupational decile. As with women, this positive relationship also plateaus out at higher occupational status scores. Turning to BMI, a negative relationship is observed for BMI and the respondent's father's occupational status for both women (Figure 33.7) and men (Figure 33.8). On average, sons and daughters of

Table 33.5: Body size by highest level of education—Women

Education	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Postgraduate	164.3	25.3	3	24	17
Bachelor	165.0	24.9	5	26	13
Diploma	163.8	26.2	4	26	22
Certificate	163.4	26.9	3	28	26
Year 12	163.6	26.0	3	30	20
Year 11 and below	161.8	27.2	3	32	28
Total	163.2	26.3	3	29	23

Note: Population weighted results.

Table 33.6: Body size by highest level of education—Men

Education	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Postgraduate	178.1	26.3	0	46	16
Bachelor	178.4	26.0	1	41	15
Diploma	177.2	26.7	1	41	20
Certificate	177.3	27.3	1	44	24
Year 12	178.3	26.6	1	39	21
Year 11 and below	176.2	27.8	1	41	30
Total	177.4	27.0	1	42	23

Note: Population weighted results.

men in the top occupational status decile have a BMI score that is 2 points lower than sons and daughters of men in the bottom occupational status decile.

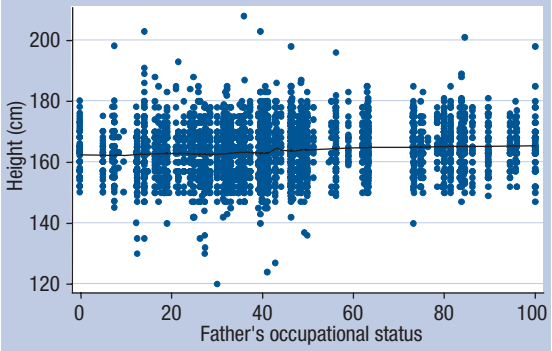
Together, these results demonstrate that respondents who grew up in more affluent households—as proxied by the father's occupational status—tend to be taller, and less likely to be overweight or obese. Since the father's occupational status is measured at an early age, it is likely that this either reflects a causal impact of family background on height and weight, or that both family background and body size are affected by some other variable, such as genetic characteristics or neighbourhood features.

Body size by marital status

In Tables 33.7 and 33.8, we present the relationship between body size and marital status for women and men. The tallest women, on average, are those women (at the time of the survey) who have never married (164.7cm). The shortest women, on average, are widowed (160.6cm). This result is perhaps not surprising as widowed women are likely to be older and their stature would have declined over the life cycle. In terms of BMI, widowed women had the highest average BMI (26.8) followed by women who were separated or divorced (26.7). Women who never married had, on average, the lowest BMI (25.0). Approximately 1 in 2 women who were either in a de facto relationship, legally married, or separated or divorced were classified as overweight or obese. For widowed women, approximately 6 in 10 women were either overweight or obese. At the other end of the spectrum, around 4 in 10 women who never married were either overweight or obese.

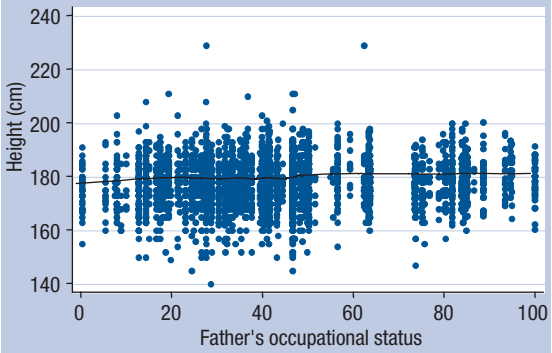
Interestingly, as with women, the tallest men, on average, are those who never married (178.6cm), followed by men in a de facto relationship (178.4cm). The height of married men, on average, was 177.0cm. The shortest men, on average, were widowed (175.6cm). In terms of body size, nearly 7 in 10 men who were married, separated or divorced, or widowed were classified as overweight or obese. Around 6 in 10 men in a de facto relationship were classified as either overweight or obese. For men who had never married, 1 in 2 were classified as overweight or obese.

Figure 33.5: Height by respondent's father's occupational status—Women



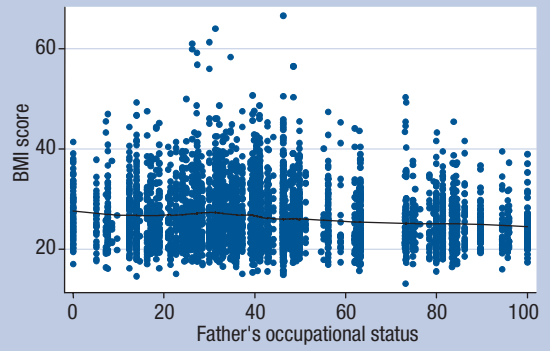
Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Figure 33.6: Height by respondent's father's occupational status—Men



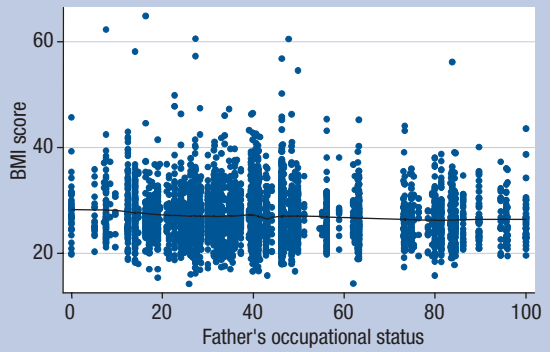
Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Figure 33.7: BMI by respondent's father's occupational status—Women



Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Figure 33.8: BMI by respondent's father's occupational status—Men



Note: Each dot denotes a respondent. Line is based on a locally weighted regression.

Body size by country of birth

Next, we compare native born Australians with first-generation migrants. Table 33.9 shows the results for women. Women who are born in Australia are, on average, 3cm taller than women born overseas. However, the average BMI of women born in Australia is higher than women born overseas (26.5 versus 25.8). In terms of body size, the proportion of overweight women is very similar for women born in Australia or overseas (29% compared to 28%). There is, however, a difference in the proportion of obese women by country of birth. 19% of women born overseas were classified as obese compared to 24% of women born in Australia. The height and BMI differences between Australian born and overseas born women are statistically significant. Breaking down the foreign born population by region of birth, the tallest female migrants are those born in New Zealand and Oceania, while the shortest are those born in Asia. The highest BMI scores are found among female migrants from Continental Europe and the former USSR, while the lowest are among migrants from Asia.

For men a similar story emerges in Table 33.10. Men born in Australia are, on average 3cm taller that their overseas born counterparts (178.0cm versus 175.5cm). The proportion of overweight men is very similar for men born in Australia or overseas (42% compared to 43%). There is, however, a difference in the proportion of obese men by country of birth. One in 5 overseas born men are classified as obese compared to 1 in 4 Australian born men. Among men, the height and obesity differences by country of birth are statistically significant. Breaking down the foreign born population by region of birth, the tallest male migrants are those in the 'Other foreign-born' category (predominantly Africa and the Americas), while the shortest are those born in Asia. The highest average BMI scores are found among male migrants from 'Other foreign-born countries', while the lowest are among migrants from Asia.

Table 33.7: Body size by marital status—Women

Marital status	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Legally married	163.0	26.6	2	30	23
De facto	164.5	26.2	3	24	23
Separated/Divorced	163.4	26.7	5	29	24
Widowed	160.6	26.8	4	39	22
Never married	164.7	25.0	8	22	18
Total	163.2	26.3	3	29	23

Note: Population weighted results.

Table 33.8: Body size by marital status—Men

Marital status	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Legally married	177.0	27.4	1	45	24
De facto	178.4	26.8	1	44	20
Separated/Divorced	176.6	27.6	2	41	25
Widowed	175.6	26.5	2	43	23
Never married	178.6	25.9	2	31	19
Total	177.4	27.0	1	42	23

Note: Population weighted results.

Table 33.9: Body size by country of birth—Women

Country of birth	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Born in Australia	163.9	26.5	3	29	24
Born in…					
New Zealand and Oceania	165.6	25.8	8	27	20
UK and Ireland	161.7	26.1	3	29	22
Continental Europe and former USSR	162.5	27.2	1	36	25
Asia	158.1	23.9	8	21	8
Other foreign born	161.7	26.9	3	26	24
All born overseas	161.3	25.8	5	28	19
Total	163.2	26.3	3	29	23

Note: Population weighted results.

Table 33.10: Body size by country of birth—Men

Country of birth	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Born in Australia	178.0	27.1	1	42	24
Born in…					
New Zealand and Oceania	177.2	27.6	0	40	28
UK and Ireland	176.5	26.9	2	44	21
Continental Europe and former USSR	175.4	27.4	0	50	22
Asia	171.3	24.8	1	34	11
Other foreign born	178.1	27.8	0	46	24
All born overseas	175.5	26.8	1	43	20
Total	177.4	27.0	1	42	23

Note: Population weighted results.

Body size by Indigenous status

Finally, we look at the correlation between body size and Indigenous status.[5] Table 33.11 shows the results for Indigenous and non-Indigenous women. On average, Indigenous women are about the same height as non-Indigenous women (163.6cm versus 163.2cm). However, the average BMI of Indigenous women is considerably higher than non-Indigenous women (28.6 versus 26.3). In terms of body size, nearly 7 in 10 Indigenous women are classified as either being overweight or obese compared to 5 in 10 non-Indigenous women. At the other end of the scale, Indigenous women are also more likely to be underweight than non-Indigenous women. Although there are only 70 Indigenous women in our sample, the BMI and obesity differences between Indigenous and non-Indigenous women are both statistically significant at the 1% level.

Table 33.12 shows the results for Indigenous and non-Indigenous men. On average, Indigenous men are about the same height as non-Indigenous men (176.6cm compared to 177.4cm). The average BMI of Indigenous men is 28.6 compared to 26.3 for their non-Indigenous counterparts. Approximately 65% of non-Indigenous men are classified as being either overweight or obese compared to 57% of Indigenous men. With 88 Indigenous men in our sample, formal statistical tests cannot reject the hypothesis that there is no height or BMI difference between Indigenous and non-Indigenous men.

Conclusion

In this article, we have sought to estimate the relationship between body size and seven characteristics that might conceivably affect it: state or territory of residence, birth year, education, father's occupational status, marital status, whether the respondent was born overseas, and Indigenous status. Across States and Territories, we find minimal differences. Across birth cohorts, we observe that today's young Australians are taller than their elders. Adjusting for the fact that individuals tend to shrink slightly as they age, we find that men born in 1976–85 are 2cm taller than those born in 1946–55, while women born in 1976–85 are 1cm taller than those born in 1946–55.

By education and parental status, the differences are larger still. University-educated respondents are 2–3cm taller than those with a Year 11 education or less, and 10–15 percentage points less likely to be obese. Those whose fathers worked in high-status jobs tend to be taller and weigh less than those whose fathers worked in low-status jobs.

Table 33.11: Body size by Indigenous status—Women

Indigenous status	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Non-Indigenous	163.2	26.3	3	29	22
Indigenous	163.7	28.6	6	35	34
Total	163.2	26.3	3	29	23

Note: Population weighted results.

Table 33.12: Body size by Indigenous status—Men

Indigenous status	*Height (cm)*	*BMI*	*Underweight (%)*	*Overweight (%)*	*Obese (%)*
Non-Indigenous	177.4	27.0	1	42	23
Indigenous	176.6	26.5	1	37	20
Total	177.4	27.0	1	42	23

Note: Population weighted results.

Across racial and ethnic groups, we observe that men and women who were born in Australia tend to be taller than those born overseas; and also more likely to be obese. Comparing Indigenous and non-Indigenous respondents, we find that Indigenous women are 12 percentage points more likely to be obese than non-Indigenous women. This pattern does not hold up among men, with Indigenous and non-Indigenous men reporting similar levels of overweight and obesity.

In a companion paper (Kortt and Leigh, 2009), we look at the relationship between body size and hourly wages. Consistent with findings from other countries, we find that taller workers tend to earn higher wages. However, we do not find any evidence that—controlling for characteristics such as age, race, education and experience—there is a systematic wage penalty to having a higher BMI. This finding differs from studies in countries such as Germany and the United States, which have tended to find that overweight and obese workers in those countries earn lower hourly wages.

Acknowledgements

We are grateful to Susanne Schmidt and Roger Wilkins for comments on an earlier draft.

Endnotes

1 For a detailed discussion of the quality of the self-reported height and weight data in HILDA, see Wooden et al. (2008).

2 Since Australians living in remote and sparsely populated areas were not in the initial sampling frame (Watson and Wooden, 2002), HILDA under-samples remote Indigenous people.

3 Previous studies have addressed this question by looking at data from school children (Loesch et al., 2000; Olds and Harten, 2001), war recruits (Whitwell et al., 1997; Nicholas et al., 1998; Shlomowitz, 2007), and data on Indigenous heights collected by early anthropological expeditions (Nicholas et al., 1998). Data from war recruits suggests a decline in heights during the late-nineteenth century (though cf. Shlomowitz 2007), and an increase in the early-twentieth century. Studies of school children suggest that today's Australian children are taller than their predecessors.

4 The Sorkin et al. (1999) formulas for cumulative height loss at a given age are for women: 0.0714Age – 0.00075Age2 – 0.000016Age3 and for men: 0.0435Age – 0.00009Age2 – 0.000015Age3. On the general topic of height decline over the lifecycle, see also Cline et al. (1989).

5 For evidence on the difference between the body sizes of Indigenous and non-Indigenous Australians in the early-twentieth century, see Nicholas et al. (1998).

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