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The Impact of Women's Weight on Health Outcomes: A problem for Now and the Future

On behalf of Investigators of the Australian Longitudinal Study on Women's Health

Abstract

Data from the Australian Longitudinal Study on Women's Health (ALSWH) highlight current trends in weight gain for Australian women. Over the first 12 years of the study there has been an overall increase in the women's weight, particularly for women in the Younger and Mid-age cohorts. At survey 1 in 1996, Younger women (aged 18-23 years) had the lowest average weight and Body Mass Index (BMI). Trends over the first four surveys, show that the BMI pattern for the Younger women (aged 28 to 33 years in 2007) is fast approaching the pattern seen for the Mid-age cohort at survey 1 (when they were aged 45 to 50 years in 1996). If this rate of weight gain continues, the Younger women will be substantially heavier by the time they reach 45, than the Mid-age cohort were at the same age. The Mid-age women in the study are also experiencing weight gain, although not as rapidly as the Younger women. At survey 1, 46% of Mid-aged women were classified as overweight or obese; at survey 4, 58% of women were in these categories.

As obesity levels rise in an ageing population, population health gains seen over the last century could be overturned. Findings from the ALSWH demonstrate the relationship between overweight and obesity and chronic disease, poorer mental and physical health, and higher health care costs. Overweight and obesity contribute significantly to poor health and disability among women in Australia. At a population level, reversing these trends has the potential to have considerable impact on the good health of women as they age, and on health and other care costs.

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Further information about the study or report is available at <http://www/alswh.org.au> .

Population Ageing And Longevity Gains

Over the last century the world has undergone an extraordinary demographic transition. The proportion of people aged over 65 is expected to increase from around 1% of the world's population 100 years ago, to an estimated 20% by the middle of the 21st century (UN 2003). In 2006, Australia had around 2.7 million people aged 65 years and over: about half (52%) of these people were aged 65–74 years, about one-third (36%) were aged 75–84, and 12% were aged 85 years and over. By 2050, the proportion of people aged 65 and over is expected to double and

the proportion aged 85 or over to triple (AIHW 2007). Much of this population ageing is related to changes in fertility rates and improvement in infant survival, however there has also been an increase in longevity.

The rate of death at all ages has slowed over the last century, and there has been a rapid increase in life expectancy. In 2004, the life expectancy at birth was 78 years for a boy born in Australia, and 83 years for a girl (AIHW 2006a). Life expectancy at age 65 has also increased since the 1960's, largely due to declines in deaths due to smoking associated diseases such as heart disease, stroke and lung cancer (AIHW 2006b). Currently, life expectancy at age 65 is 82 years for men and 86 years for women (AIHW 2006a).

Will life expectancy continue to rise in the future? Extrapolation of current trends in life expectancy, and of longitudinal data showing improvements that can be achieved with better lifestyle, indicates that life expectancy will continue to increase. The magnitude of this increase depends on how mutable some risk factors are, the ability to alter outcomes at older ages, and emergent threats to survival including viral pandemics and obesity. If current global trends in obesity continue, we may actually see a decrease in life expectancy, as well as a decrease in healthy life expectancy (Olshansky *et al.* 2005).

Maintenance of the health and productivity of people as they age is of particular importance for the sustainability of health services and welfare systems. However, the USA Health and Retirement Study has found that rather than becoming more healthy, successive cohorts of people aged 51-56 are in relatively poorer health, reporting more difficulty with daily tasks, more pain, more chronic conditions, more psychiatric problems and higher use of alcohol (Soldo *et al.* 2006). Similar findings have also been reported for people in the United Kingdom. (Banks *et al.* 2006).

Changing Weight – The Obesity Epidemic

The Australian Longitudinal Study on Women's Health (ALSWH) began in 1996 and involves three large, nationally representative, cohorts of Australian women:

- Younger women, aged 18 to 23 years when first recruited in 1996 (n=14247)
- Mid-aged women, aged 45 to 50 years in 1996 (n=13716)
- Older women, aged 70 to 75 years in 1996 (n=12432)

The women have been resurveyed at least four times over the past 11 years providing a large amount of data on the women's lifestyles and health outcomes including changes in weight (Lee *et al.* 2005).

Table 1 Schedule of Surveys for the Australia Longitudinal Study on Women's Health

	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 7
Younger	(1996) 18-23 yrs	(2000) 22-27 yrs	(2003) 25-30 yrs	(2006) 28-33 yrs	(2009) 31-36 yrs	(2012) 34-39 yrs	(2015) 37-42 yrs
Mid-aged	(1996) 45-50 yrs	(1998) 47-52 yrs	(2001) 50-55 yrs	(2004) 53-58 yrs	(2007) 56-61 yrs	(2010) 59-64 yrs	(2013) 62-67 yrs
Older	(1996) 70-75 yrs	(1999) 73-78 yrs	(2002) 76-81 yrs	(2005) 79-84 yrs	(2008) 82-87 yrs	(2011) 85-90 yrs	(2014) 88-93 yrs

At each survey women were asked to report their height and weight. These self-reported data are used to calculate Body Mass Index (BMI) calculated as weight (kg) divided by the square of

height (m²), and categorised as: Underweight (< 18.5); healthy weight (18.5 - <25); overweight (25 - <30); obese (≥30) using criteria defined by the WHO (WHO 1999). Means and 95% Confidence intervals for Survey 1 weight, height and BMI for women who provided data for Surveys 1, 2, 3, and 4 are presented in Table 2, and the change in BMI between Survey 1 and Survey 4 is shown in Figure 1.

Table 2. Mean and 95% Confidence Intervals for weight, height and BMI for Younger, Mid-aged and Older Cohort in 1996

Cohort		Mean	95%CI
Younger N=5609	Weight	62.7	62.4-63.0
	Height	165.8	165.7-166.0
	BMI	22.8	22.6-22.9
Mid-age N=7507	Weight	68.8	68.3-22.9
	Height	163.0	162.9-163.1
	BMI	25.7	25.6-25.8
Older N=6264	Weight	65.8	65.5-66.1
	Height	161.5	161.3-161.6
	BMI	25.2	25.1-25.4

Data for women who answered questions on height and weight on all four surveys in each cohort.

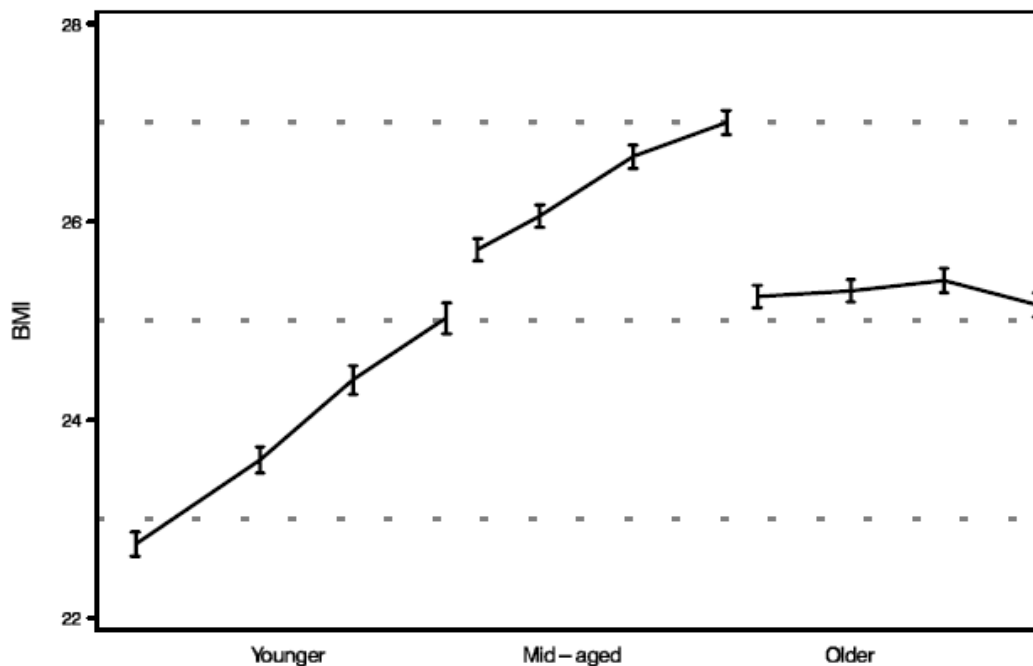


Figure 1. Mean self-reported weight, height and calculated BMI with 95% confidence intervals for each cohort (Younger, Mid-aged, Older) for Surveys 1, 2, 3 and 4 from 1996 to 2006

Reproduced from: *Women's weight: Findings from the Australian Longitudinal Study on Women's Health. Report prepared for the Australian Government Department of Health and Ageing June 2007. available at: <http://www/alswh.org.au> (Last accessed 15 March 2008)*

At each survey, there has been an overall increase in the women's weight, particularly for women in the Younger cohort. At Survey 1, the mean weight of the women in the Younger cohort was 62.7 kg. This was almost 6 kg lighter than women in the Mid-age cohort (See Table 2). The Younger women were also taller, and so their BMI was considerably lower than the Mid-age cohort, with the Younger women having an average BMI of 22.8 which is well within the healthy weight range. Over the next ten years, the women in the Younger cohort gained a mean of 6.32 kg (between Survey 1 in 1996 and Survey 4 in 2006) and the mean BMI for these women increased to 25.03. The proportion of women in the healthy weight range reduced from 70.3% to 58.6%, and the proportion of women in the obese range tripled, from 5.5% at Survey 1 to 14.8% at Survey 4.* The rapid increase of weight in this cohort means that the BMI pattern for the Younger women aged 28-33 years of age is fast approaching the pattern seen for the Mid-age cohort when they were 45-50 years of age. If this rate of weight gain continues, by the time they reach 45 the cohort of Younger women will be substantially heavier than the Mid-age women were at the same age.

Mid-aged women had the highest weight and BMI at Survey 1. At this time, 52.5% of Mid-age women were in the healthy weight range, 28.4% were overweight, and 17.6% were obese. On average, the women gained 3.43 kg in the eight years between Survey 1 in 1996 and Survey 4 in 2004. This rate of weight gain was not as rapid as observed among the Younger cohort. By Survey 4, 40.3% of Mid-age women were in the healthy weight range, 33.7% were overweight, and 24.9% were obese.

The Older women had a mean weight loss of 1.67 kg over the nine years between Survey 1 in 1996 and Survey 4 in 2005. However, there was also a decrease in mean height (around 1.85 cm), so that the average BMI for Older women did not change greatly across the first three Surveys. There was a reduction in average BMI at Survey 4. Between Survey 1 and Survey 4, the main changes in BMI categories for women in the Older cohort were a slight increase in the proportion classified as obese (increasing from 12.3% to 13.1%), a reduction in the proportion classified as healthy weight (from 51.5% to 49.9%) and an increase in the proportion classified as underweight (from 2.3% to 4.5%).

Weight and Health

For all age groups, Body Mass Index was the most important risk factor for self-reported hypertension, heart disease, diabetes, asthma, osteoporosis, and arthritis (Lucke *et al.* 2007). Table 3 shows the relative risk estimates for common chronic diseases reported by the women at the time of Survey 3. Compared with women in the healthy weight range of BMI, Younger and Mid-age women in the overweight range were twice as likely to report hypertension, diabetes; and obese women 3 to 5 times more likely to report these conditions. Effects were generally stronger for incident cases than for prevalence.

The effects of overweight and obesity were not as strong among women in the older cohort, and overweight/obesity was marginally protective against osteoporosis among older women.

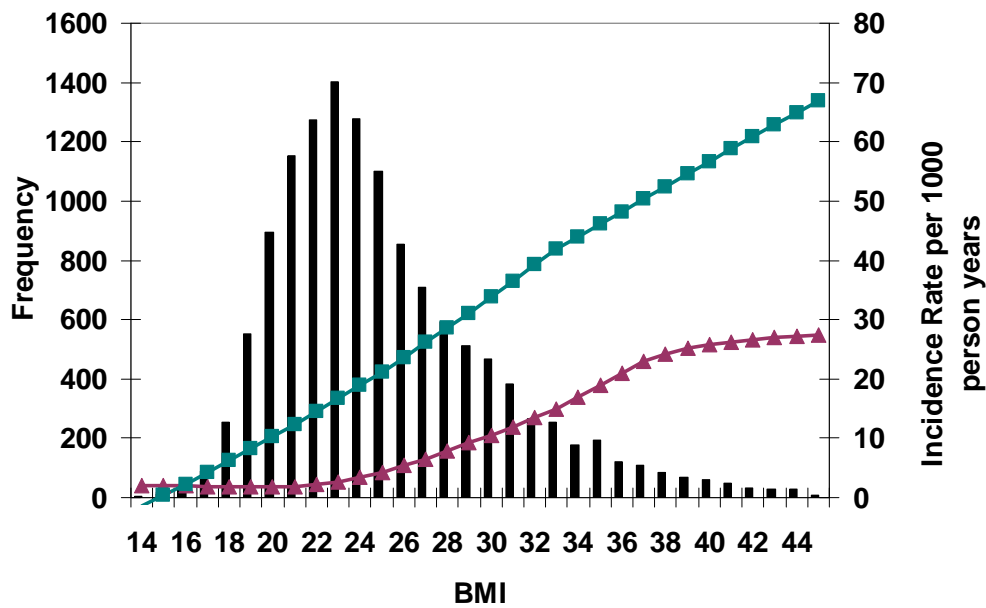
* These data are only provided for women who answered questions on height and weight on all four surveys in each cohort. Women whose data are included in the analyses were more likely to be categorised as "healthy weight" at Survey 1 than women who did not provide data for all four surveys.

Table 3. Relative risk estimates (and 95% confidence intervals) for chronic conditions from Survey 1 to Survey 3 and BMI levels at Survey 1 for participants in the Australian Longitudinal Study of Women's Health*

	Younger women		Mid-age women		Older women	
	Overweight	Obese	Overweight	Obese	Overweight	Obese
Hypertension						
Prevalence	2.2 (1.8, 2.7)	3.9 (3.1, 4.9)	1.7 (1.6, 1.9)	3.1 (2.8, 3.4)	1.3 (1.2, 1.4)	1.6 (1.5, 1.6)
Incidence	2.3 (1.4, 3.8)	3.9 (2.1, 7.3)	2.0 (1.7, 2.3)	3.3 (2.9, 3.9)	1.3 (1.2, 1.5)	1.4 (1.2, 1.6)
Heart Disease						
Prevalence			1.3 (0.9, 1.8)	1.8 (1.2, 2.5)	1.1 (0.9, 1.2)	1.4 (1.2, 1.6)
Incidence			1.4 (1.1, 2.0)	2.3 (1.7, 3.2)	1.1 (0.9, 1.2)	1.2 (1.00, 1.4)
Diabetes						
Prevalence	1.8 (1.1, 3.0)	2.3 (1.2, 4.3)	2.0 (1.4, 2.8)	5.1 (3.8, 7.0)	1.4 (1.2, 1.7)	2.4 (2.0, 2.9)
Incidence	1.1 (0.5, 2.2)	4.7 (2.5, 8.9)	3.2 (2.2, 4.5)	8.4 (6.1, 11.6)	2.0 (1.6, 2.5)	3.7 (2.9, 4.8)
Asthma						
Prevalence	1.3 (1.2, 1.4)	1.3 (1.1, 1.5)	1.3 (1.1, 1.4)	1.5 (1.3, 1.7)	1.2 (1.1, 1.4)	1.5 (1.3, 1.7)
Incidence	2.1 (1.5, 3.1)	1.3 (0.7, 2.5)	1.3 (1.1, 1.7)	2.00 (1.6, 2.5)	1.5 (1.1, 1.9)	1.8 (1.3, 2.5)
Osteoporosis						
Prevalence			1.2 (0.95, 1.6)	1.4 (1.1, 1.9)	0.9 (0.8, 1.0)	0.9 (0.8, 0.98)
Incidence			0.6 (0.5, 0.8)	0.8 (0.6, 1.0)	0.8 (0.7, 0.9)	0.9 (0.7, 1.0)
Arthritis						
Prevalence			1.4 (1.3, 1.6)	2.0 (1.7, 2.2)	1.2 (1.2, 1.3)	1.6 (1.5, 1.7)
Incidence			1.2 (1.00, 1.4)	1.2 (1.00, 1.5)	1.3 (1.1, 1.5)	1.4 (1.2, 1.7)

* Referent category: Healthy weight
Adapted from: Lucke et al. 2007.

Figure 2 further illustrates the association between BMI and five year incidence of diabetes and hypertension between Survey 1 in 1996 and Survey 3 in 2001. The incidence of these conditions is substantially higher at higher levels of BMI. If the population distribution of BMI continues to shift to the right (around a higher mean), then it is likely that there will be a rapid increase in the population incidence of these conditions.



Figure

2: Distribution of BMI in 13,716 women aged 45-50 years in 1996 (dark bars). Lines show the incidence of hypertension (-■-) and diabetes (-▲-) between 1996 and 2004.

(Adapted from Brown et al. 2007)

Composite scores for physical and mental health obtained from the Short-Form 36 (SF-36) health profile (Ware and Sherbourne 1992), are used to assess general health and wellbeing in every ASLWH survey. According to these scores (higher scores are optimal), women in all three cohorts have experienced declining physical health over the course of the study, however, those who were underweight or in the healthy weight range had higher mean scores than overweight and obese women at Survey 1. Change in physical health scores for the Mid-age cohort is shown in Figure 3. In contrast, mental health scores have increased over time for the Younger and Mid-aged cohorts. In all three cohorts, mental health scores for Survey 1 were lowest for women who were underweight. Among the mid-age and older women, women in the healthy weight range had higher mental health scores than women in the obese category (see Figure 4).

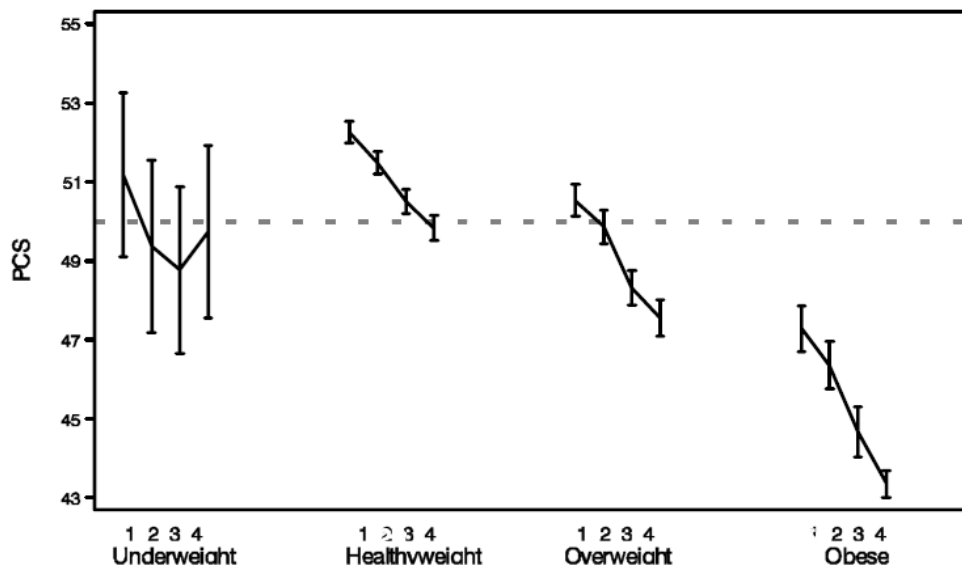


Figure 3. Mean physical health component scores (PCS at Survey 1,2, 3 and 4 by BMI category at Survey 1 for the Mid-aged cohort.

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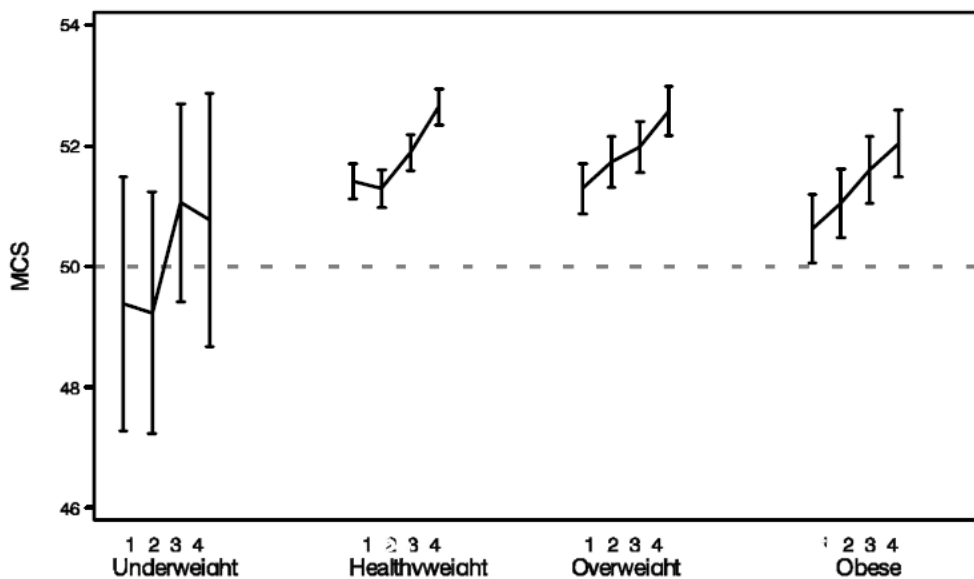


Figure 4. Mean mental health component score (MCS) at Surveys 1,2 3,and 4, by BMI category at Survey 1 for the Mid-aged cohort.

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These data show the considerable impact of obesity on women's well-being. This impact can be further quantified by comparing SF-36 subscale scores across the cohorts. For example, the difference in physical function scores for a healthy weight 25 year old and an obese 25 year old were similar to the differences between healthy weight 25 year old and a healthy weight 55 year old (See Table 4).

Table 4. SF-36 physical function sub-scale scores for women of different ages and BMI categories

Age	SF-36 Physical function sub-scale score				
	Healthy Weight		Obese		Difference in means
	Mean	95% CI	Mean	95% CI	
25 years (non-pregnant)	93.5	93.1-93.9	86.1	83.8-88.4	7.4
55 years	85.2	83.9-86.4	72.4	70.3-74.4	12.8
80 years	63.7	61.6-65.7	40.5	37.0-43.9	23.2

From: Byles and Powers, unpublished data 2008.

Potential Impact On Healthy Ageing

These data from the ALSWH emphasise the growing problem of obesity among Australian women. The longitudinal data provided by the study show the rapid increase in weight among Younger women, a problem that is underestimated by simple cross-sectional comparisons. Indeed, cohort differences in weight and BMI at Survey 1 would suggest the Younger women had healthier weight profiles than the Mid-age women. As these women age, however, their weight is increasing rapidly and their weight profiles now resemble those of the Mid-age cohort at the start of the study. Unless there is a significant reduction in the rate of weight increase in this Younger cohort, they will have much higher prevalence of obesity and overweight when they reach 45 years of age (than was evident in the Mid-age cohort in 1996), with a consequent increase in associated conditions and disabilities.

As Bennett notes, Australia, like most of the world, is in the midst of an obesity epidemic (Bennett *et al.* 2004) and the population is getting heavier as well as older. Among Australians approaching retirement age, the prevalence of obese Australians is around 25–30% (AIHW 2007), and people continue to gain weight as they gain years, at least into their mid-70s. The likely consequences of overweight and obesity for these people, are a reduction in their healthy life expectancy and, possibly, life expectancy. This has implications for public health, for health-care costs, for aged care services, and also for carers and their wellbeing (AIHW 2007).

Jagger *et al.* (2006) have attempted to forecast future levels of disease and disability taking account of increasing levels of obesity. They identify that population obesity could have the following effects:

- **On arthritis:** an increase in both the incidence of arthritis and its disabling effects. Obesity contributes to around 20 per cent of arthritis, and doubles the risk of disability at older ages (Peeters *et al.* 2004).
- **On CVD:** increased prevalence of stroke and CHD due to rising levels of obesity, offset by improvements in other risk factors; but decreased case-fatality and small reduction in overall mortality from stroke and CHD could decrease due to further improvements in treatments.

The impact of obesity on prevalence, incidence and burden of illness associated with diabetes has also been noted. Dunstan *et al.* (2002) found that the increasing prevalence of obesity in Australia has been a significant contributing factor to the increasing prevalence of diabetes across all age groups. The prevalence of type 2 diabetes in particular is rising and set to escalate further with increasing obesity in the population. According to the NSW Department of Health, the incidence of diabetes in NSW is predicted to increase by 127 per cent between 2001 and

2026. This increase in prevalence of diabetes will also impact substantially on complications associated with diabetes including heart disease, stroke, limb amputation, renal failure and blindness (NSW Department of Health 2006).

Analyses of data from the mid-age cohort of the ASLWH have shown that women's risk of developing type 2 diabetes was more closely related to their initial BMI (at age 45-50) than to subsequent eight year weight change (Mishra et al 2007). These findings suggest that it may already be too late to halt the increase in incidence of type 2 diabetes after this age. While childhood obesity prevention strategies are important, the data presented here show that weight gain is particularly marked when women are in their twenties, and suggest that public health initiatives which focus on prevention of weight gain from early adulthood are urgently required. With continued weight gain through their thirties and forties, this generation of young women is likely to face more weight related health problems in old age than their mothers' or grandmothers' generations.

We have begun to see population ageing and increasing life expectancy as a triumph of modern times. However, it is worth considering that an increase in life expectancy is not inevitable, and that there may be continued increasing pressure on the health care system as a direct effect of the increasing weight of young and mid-aged Australians.

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