



School of Public Health
University of Sydney

Does my bum look big in this? Overweight and obesity in Australian adults: Implications of errors in self reported height and weight

**Alison Hayes, Michael Kortt, Philip
Clarke and Jason Brandrup**



**More than half of adults are overweight
and the numbers are increasing: ABS**
January 25, 2008



Recent Reports/headlines

- **Overweight and Obesity in Adults, Australia, 2004-05 (cat. No. 4719.0)**
- **Australia's Future 'Fat Bomb' April 2008 Baker Heart Research Institute**
- **National preventative health taskforce
Technical report No 1 Obesity in Australia: a need for urgent action. October 2008**
- **"Nation in state of denial on obesity"**
- **"Half all adults say they are too fat"**
- **"Australia pips US as worlds fattest nation"**



Aim

- **To derive correction equations based on nationally representative data, for the error associated with self-reported height and weight and to apply these to recent estimates of overweight and obesity in the Australian adult population.**



Results from other studies

- **Bolton-Smith et al 2000 J.Epidemiol Comm Health; Scottish study:** both men and women underestimate height and weight. BMI estimates not affected by bias
- **Spencer et al 2001 Public Health Nutrition. Oxford. British study.** Height overestimated, weight underestimated. 22.4% men and 18% women misclassified according to self reported info
- **Nyholm et al Obesity 2007; 15:197-202.** Swedish study (n=1703 ; men and women overestimate height (men: 0.3cm women: 0.4cm) and underestimate weight (men : -1.6kg women:-1.8kg) Net result BMI 0.5 – 0.7 points higher than reported
- **Wada et al Int J Obesity 2005; 29:1093-9.** Japanese study in workplace. Self reported height and weight generally reliable. BMI from self reported data only slightly smaller than based on measured data. Bias affected by BMI and age and presence of diabetes.
- **ABS How Australians measure up 1998** BMI approx 1 point higher then reported



Overview

- **Data sources NNS 1995, NHS surveys 89-2005**
- **What factors influence reporting error in Australia? Is there a systematic bias?**
- **Can we correct for error in self-reported information?**
- **Evaluation of different correction algorithms**
- **What is the implication for 'true' levels of overweight and obesity in Australia?**



1995 National Nutrition Survey

- Conducted between Feb 1995 and March 1996
- A sample of participants of 1995 NHS were invited to participate (77% agreed)
- 13,858 people aged over 2 years
- Food and beverage intake, habits and attitudes to food, physical measurements
- Measured height and weight.
- 80% of those who initially agreed, completed an interview.



ABS National Health surveys

- Individuals participating in the last four ABS National Health Surveys, conducted in:
 - 1989-90, 1995, 2001, 2004-5.
 - N=54,241, 53,828, 26,862, 25,906
- Households selected at random using stratified area sampling plan
- Urban and rural areas throughout all states and territories
- Non-institutionalized residential population;
- Collects self-reported information on health status, health related aspects of lifestyle, use of health services, demographic and socio-economic factors
- Response rate > 92%



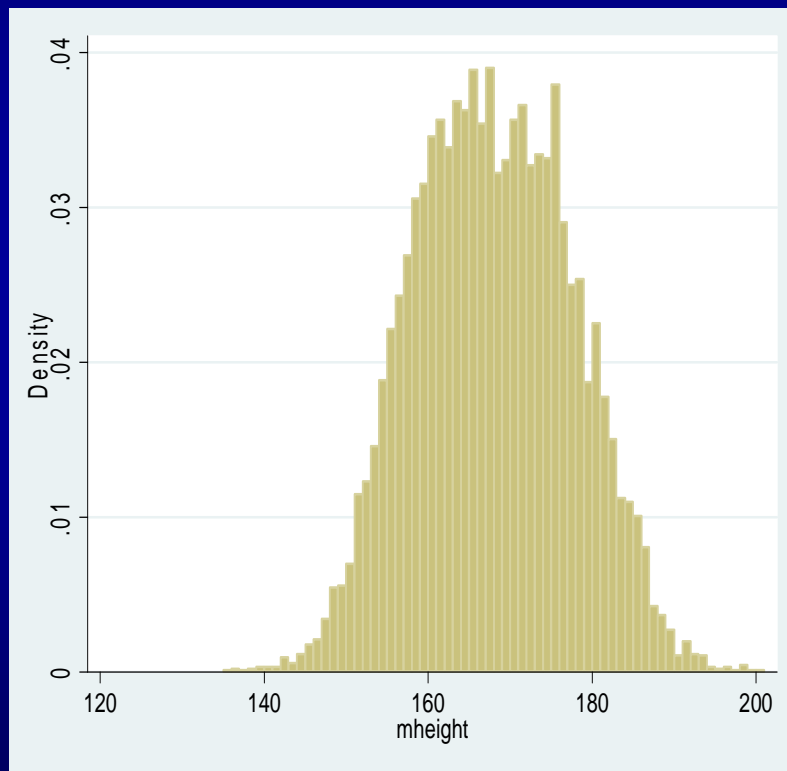
Height and weight questions NHS

NHS 1989	NHS 1995	NHS 2001	NHS 2004/5
How tall are you without shoes? How much do you weigh without clothes and shoes?	How tall are you without shoes? How much do you weigh?	How tall are you without shoes? How much do you weigh?	How tall are you without shoes? How much do you weigh?

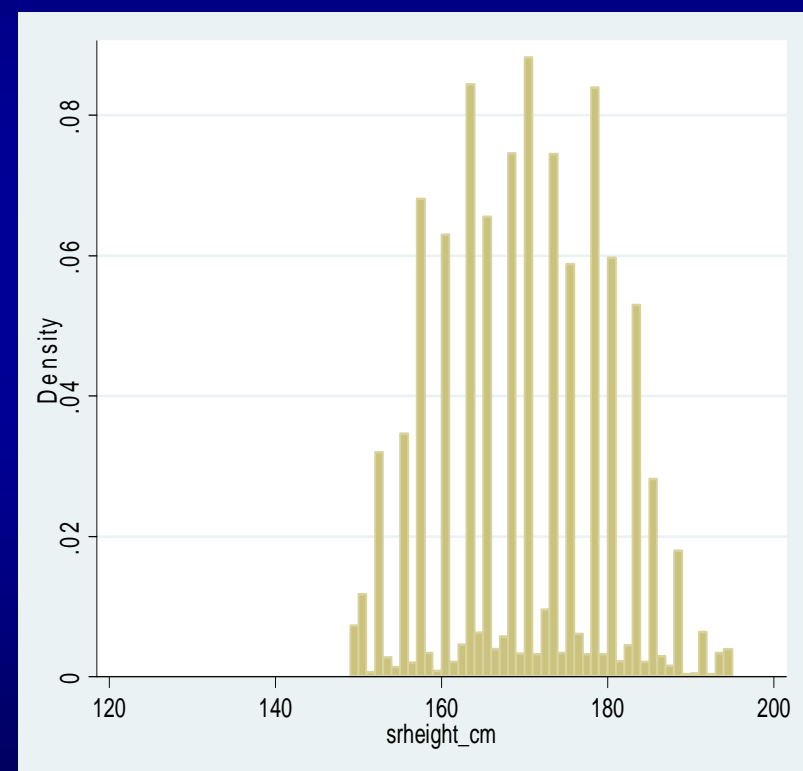


Height Distributions 1995 NNS/NHS

Measured height



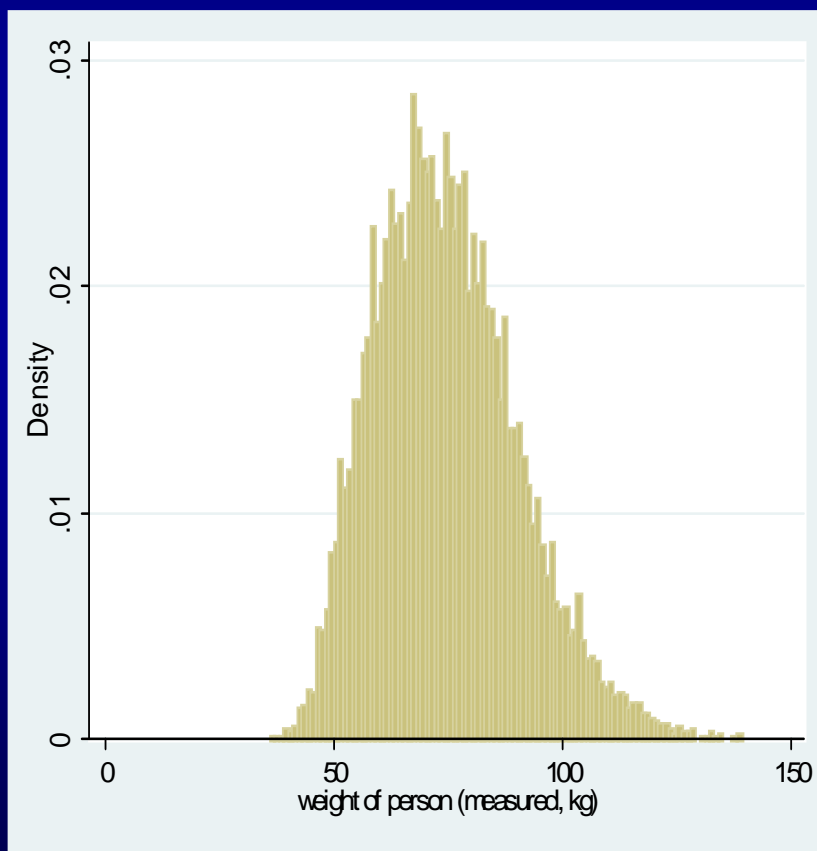
Self-reported height



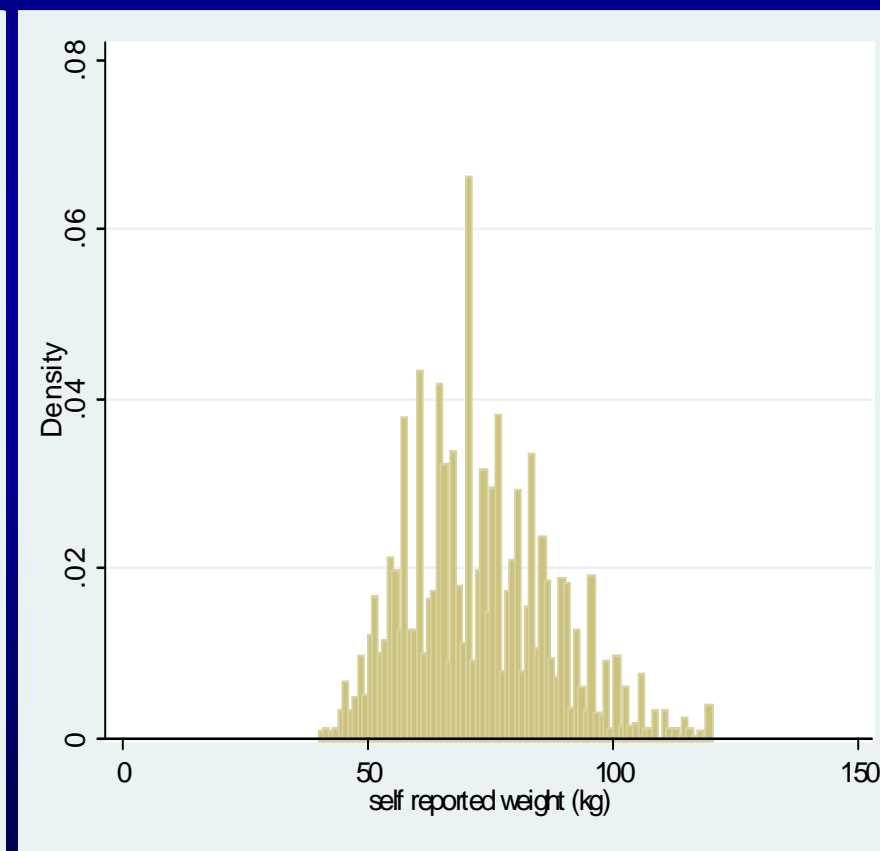


Weight distributions 1995 NNS/NHS

Measured weight



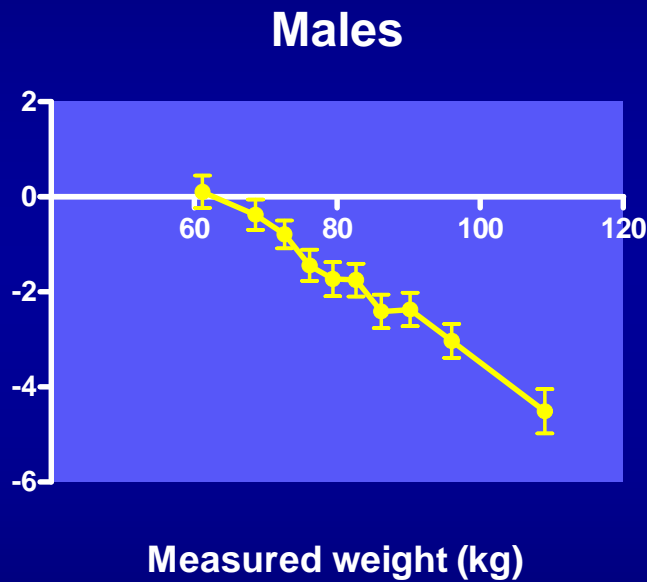
Self-reported weight



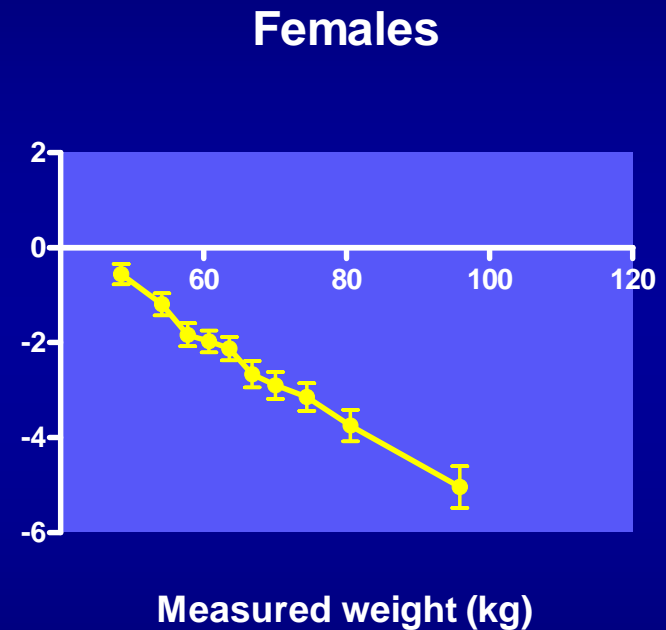


Weight error by actual weight

Mean +/- 95% CI error in weight (kg)



Mean +/- 95% CI error in weight (kg)



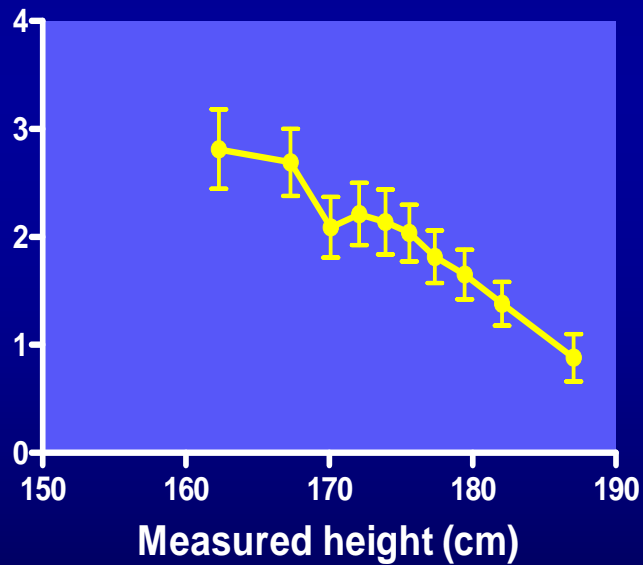
Error = self-reported minus actual weight (kilograms)



Height error by actual height

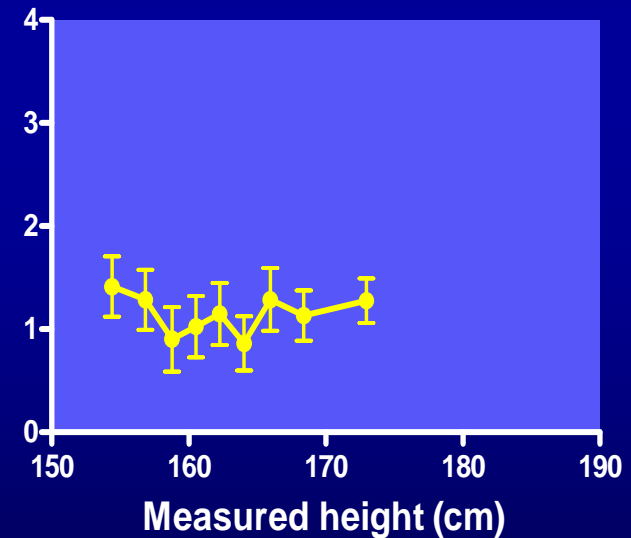
Mean +/- 95% CI error in height (cm)

Males



Females

Mean +/- 95% CI error in height (cm)

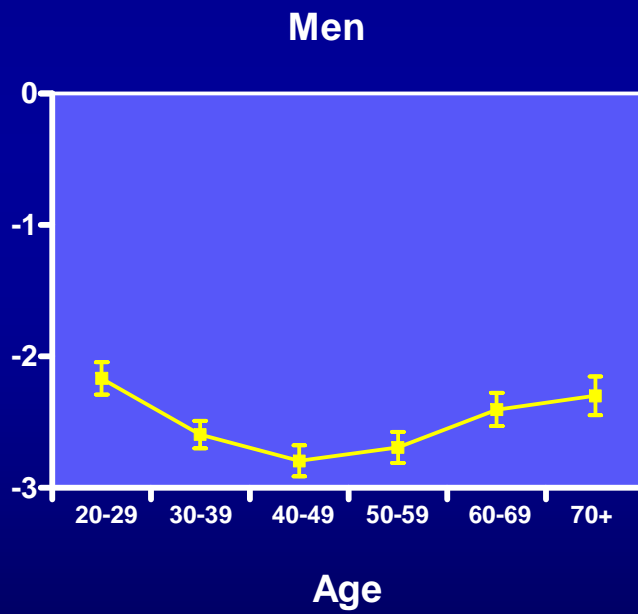


Error = self-reported minus measured height in cm

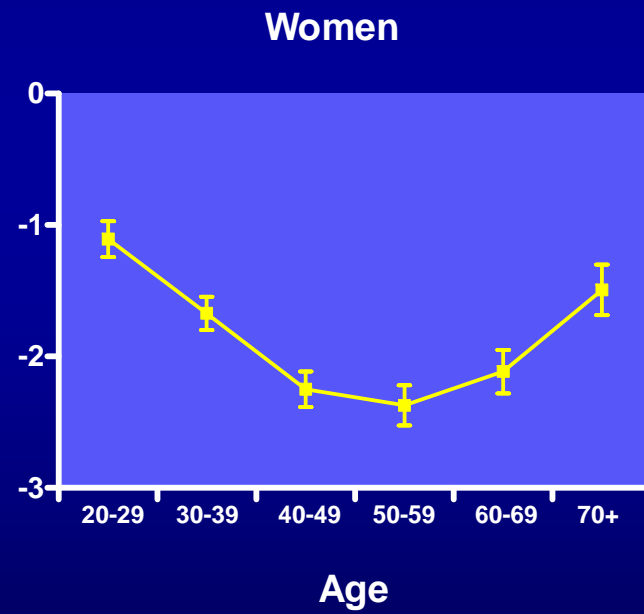


Weight error by age

Mean \pm 95% CI error in weight (kg)



Mean \pm 95% CI error in weight (kg)

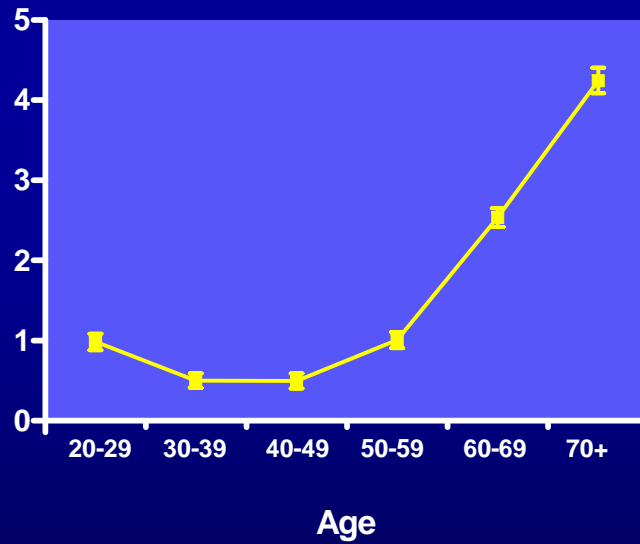




Height error by age

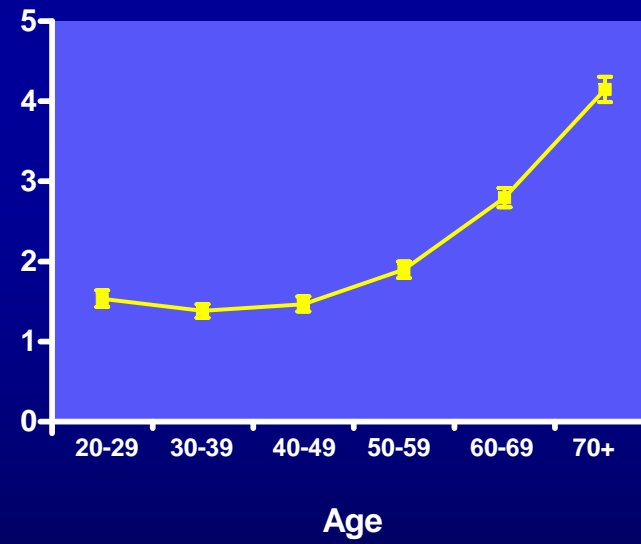
Mean +/- 95% CI error in height (cm)

Men



Mean +/- 95% CI error in height (cm)

Women





Summary statistics 1995

Variable	Self-reported (NHS)	Measured (NNS)	Reporting error
Males (n = 4,115)			
Height (cm)	176.68 (7.07)	174.71 (7.04)	1.97 (2.89)
Weight (kg)	80.31 (12.71)	82.14 (13.55)	-1.82 (3.87)
BMI	25.71 (3.69)	26.89 (4.01)	-1.18 (1.52)
Females (n = 4,320)			
Height (cm)	162.67 (6.98)	161.34 (6.70)	1.34 (3.08)
Weight (kg)	64.69 (12.66)	67.20 (13.55)	-2.51 (3.27)
BMI	24.45 (4.62)	25.82 (5.00)	-1.37 (1.58)

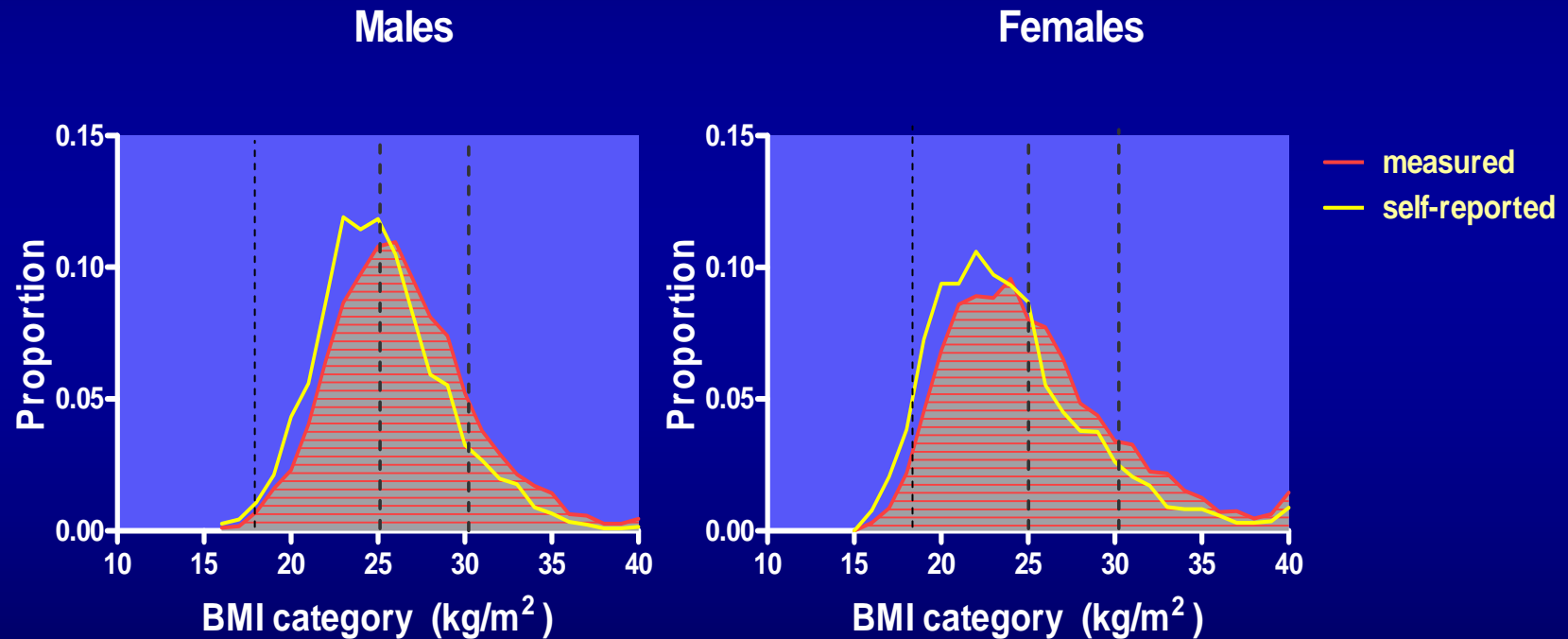
Reporting error = self- reported minus measured

Individual with missing height or weight omitted.

Outliers (> 4sd) also omitted



BMI distribution: 1995



BMI : Normal 18.50 - 24.99; overweight >25; obese>30



Derivation of correction equations from 1995 data

- N=4115 men; 4320 women over 20 yrs
- OLS regression
- Height and weight correction
- Direct BMI correction
- Simple models

$$(y = \beta + x_1\beta_1 + \varepsilon)$$

- Extended models

$$(y = \beta + x_1\beta_1 + x_2\beta_2 + x_3\beta_3 + x_4\beta_4 + \dots + \varepsilon)$$



Covariates in multiple regression models for reporting error

- **Self-reported height/weight/BMI**
- **Age**
- **Education proxy**
- **Income**
- **Smoking status**
- **Marital status**
- **Employment status**
- **Country of birth**



Simple correction equations for males

Variable	Height error		Weight error		BMI error	
	β	SE	β	SE	β	SE
Constant	-0.402**	0.204	-0.950***	0.221	-1.172***	0.201
Height (SR)	0.089***	0.007				
Weight (SR)			-0.022***	0.006		
BMI (SR)					-0.005	0.008
Adj R ²	0.914		0.954		0.852	

Male reporting his weight to be 80kg

Reporting error = $-0.95 - 0.022 \times (80 - 40) = -1.83$

Actual weight = $80 - (-1.83) = 81.8 \text{ kg}$



Extended regression equations - male

Variable	Height error		Weight error		BMI error	
	β	SE	β	SE	β	SE
Constant	0.591 [*]	0.323	-0.658 ^{***}	0.238	-0.705 ^{***}	0.070
Height ⁴	0.154 ^{***}	0.008				
Weight ⁵	-0.041 ^{***}	0.004	-0.017 ^{***}	0.006		
BMI ⁶					NS	-
<u>Age</u>						
30-39	0.253 [*]	0.131	-0.515 ^{***}	0.175	-0.163 ^{**}	0.069
40-49	0.480 ^{***}	0.141	-1.041 ^{***}	0.182	-0.384 ^{***}	0.074
50-59	1.017 ^{***}	0.151	-1.160 ^{***}	0.196	-0.580 ^{***}	0.081
60-69	1.858 ^{***}	0.167	-0.874 ^{***}	0.206	-0.758 ^{***}	0.084
70-74	2.809 ^{***}	0.233	-0.538 ^{**}	0.296	-0.921 ^{***}	0.130
75+	3.560 ^{***}	0.259	NS	-	-0.933 ^{***}	0.128
Income	-0.032 ^{**}	0.015	NS	-	NS	-
Smoker	0.265 ^{**}	0.110	0.654 ^{***}	0.151	0.116 [*]	0.062
Ex-smoker	0.192 ^{**}	0.096	NS	-	-0.090 [*]	0.054
<u>Left school</u>						
15-17	-0.240 [*]	0.129	NS	-	NS	-
18+	-0.441 ^{***}	0.157	NS	-	NS	-
Born in Australia	NS	-	NS	-	-0.099 [*]	0.053
Married	-0.237 ^{**}	0.100	NS	-	NS	-
Employed	NS	-	NS	-	NS	-
Adj R ²	0.888		0.977		0.862	



Example

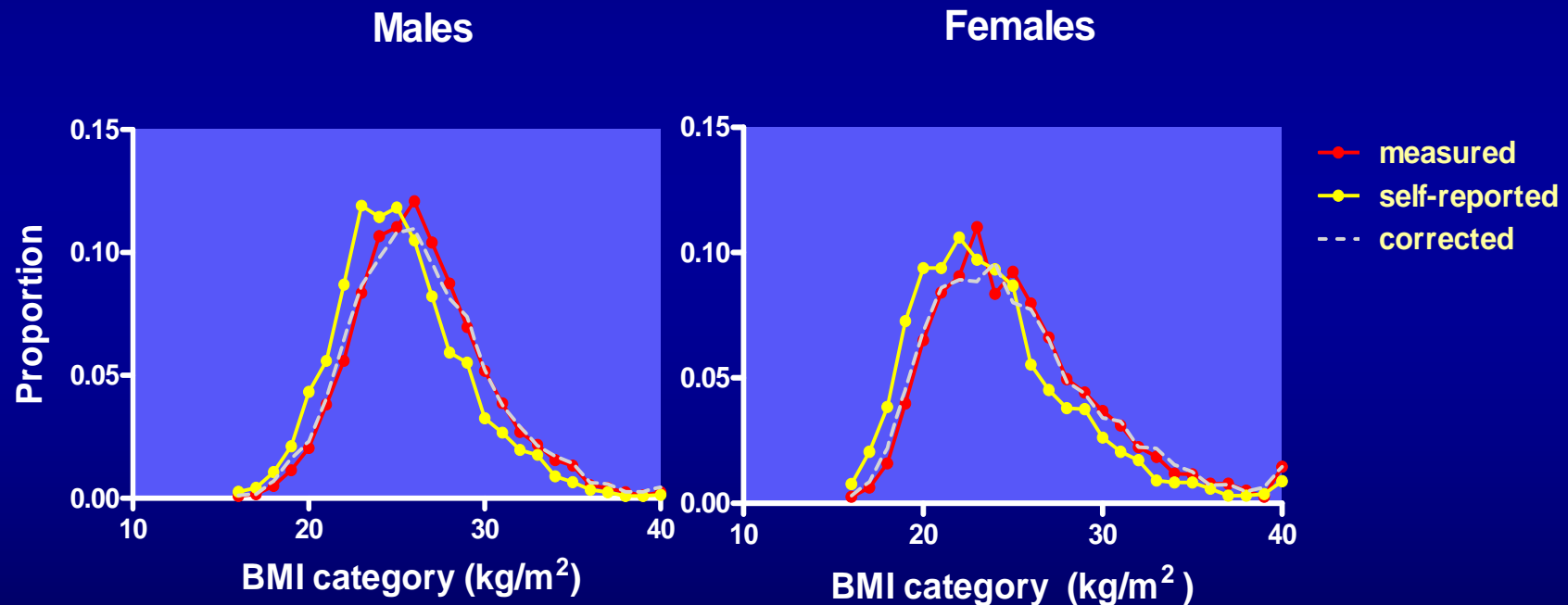
Male smoker 45 yrs old, reporting his weight to be 80kg

Wt Error= $-0.658 - 0.017 \times (80 - 40) - 1.041 + 0.654 = -1.73$

Actual weight = $80 - (-1.73) = 81.7\text{kg}$



Correcting self reported height with extended height and weight correction equations





Comparison of different correction algorithms-women

	% overweight	% obese	% overweight or obese
Measured 1995 (95% CI)	31.5 (30.1-32.9)	17.9 (16.7-19.0)	49.4 (47.9-50.9)
Self-reported 1995	26.3	11.4	37.7
Hgt wgt correction			
Simple	33.3	16.8	50.1
Extended	33.2	17.0	50.2
BMI correction			
Simple	33.5	16.6	50.1
Extended	32.9	17.2	50.0



Comparison of different correction algorithms - men

	% overweight	% obese	% overweight/obese
Measured (95% CI)1995	46.8 (45.2-48.3)	19.4 (18.2-20.7)	66.2 (64.8-67.7)
Self-reported 1995	42.0	12.2	54.2
Height and weight correction			
Simple	48.2	18.8	67.0
Extended	49.2	18.4	67.6
BMI correction			
Simple	50.4	17.9	68.3
Extended	49.6	18.5	68.1

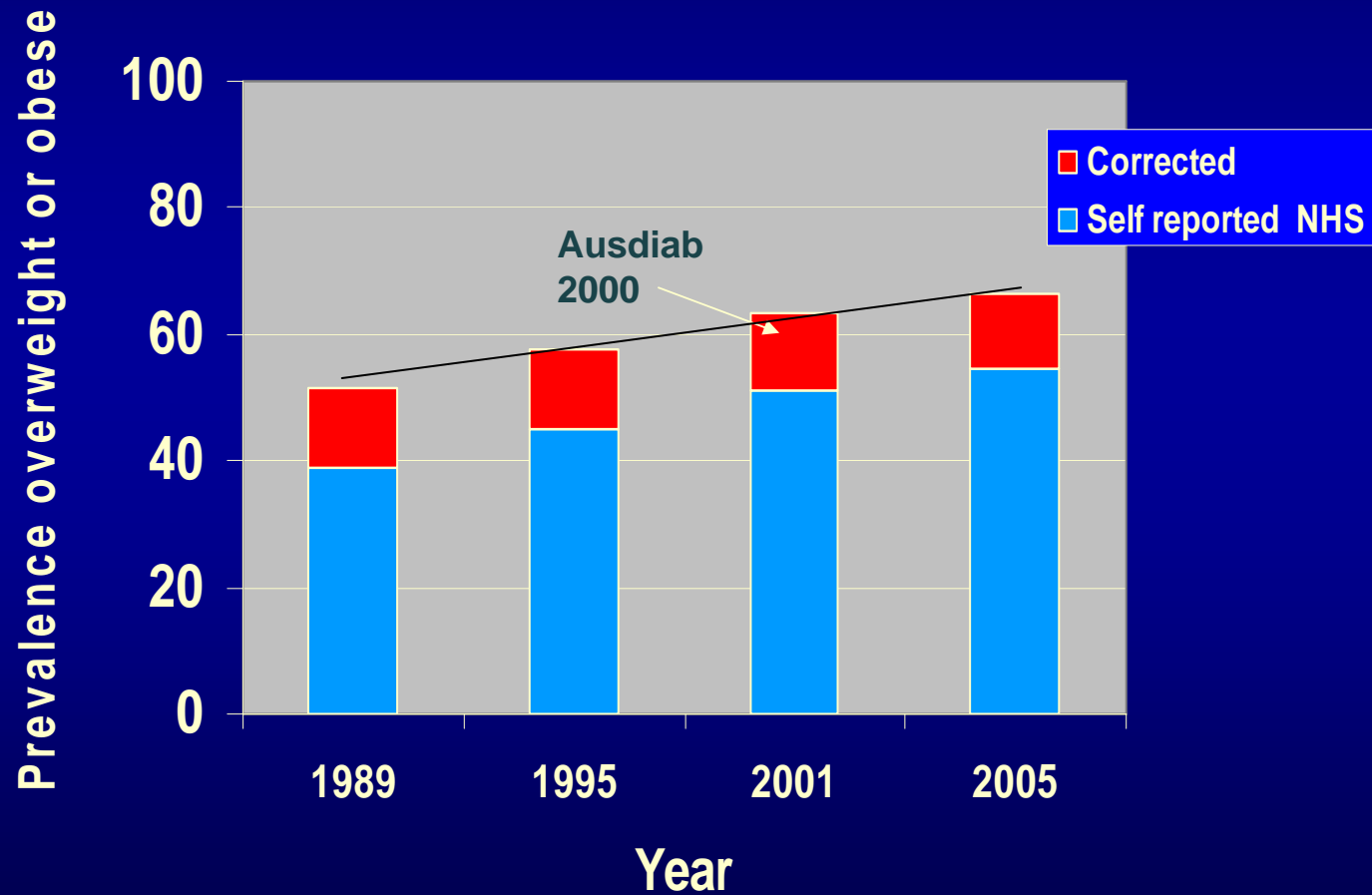


Correction equations applied to NHS data

NHS survey	N	Males		Females	
		Self reported	Corrected	Self reported	Corrected
Overweight					
1989/90	35,880	37.5	45.9	22.3	29.3
1995	34,097	40.9	48.4	25.3	32.0
2001	15,832	43.0	48.6	26.0	32.1
2005	17,153	43.8	48.8	28.4	33.1
Obese					
1989/90	35,880	8.5	13.5	9.6	14.0
1995	34,097	11.9	17.9	11.9	17.1
2001	15,832	16.0	23.3	17.0	22.8
2005	17,153	19.4	26.7	17.1	24.1

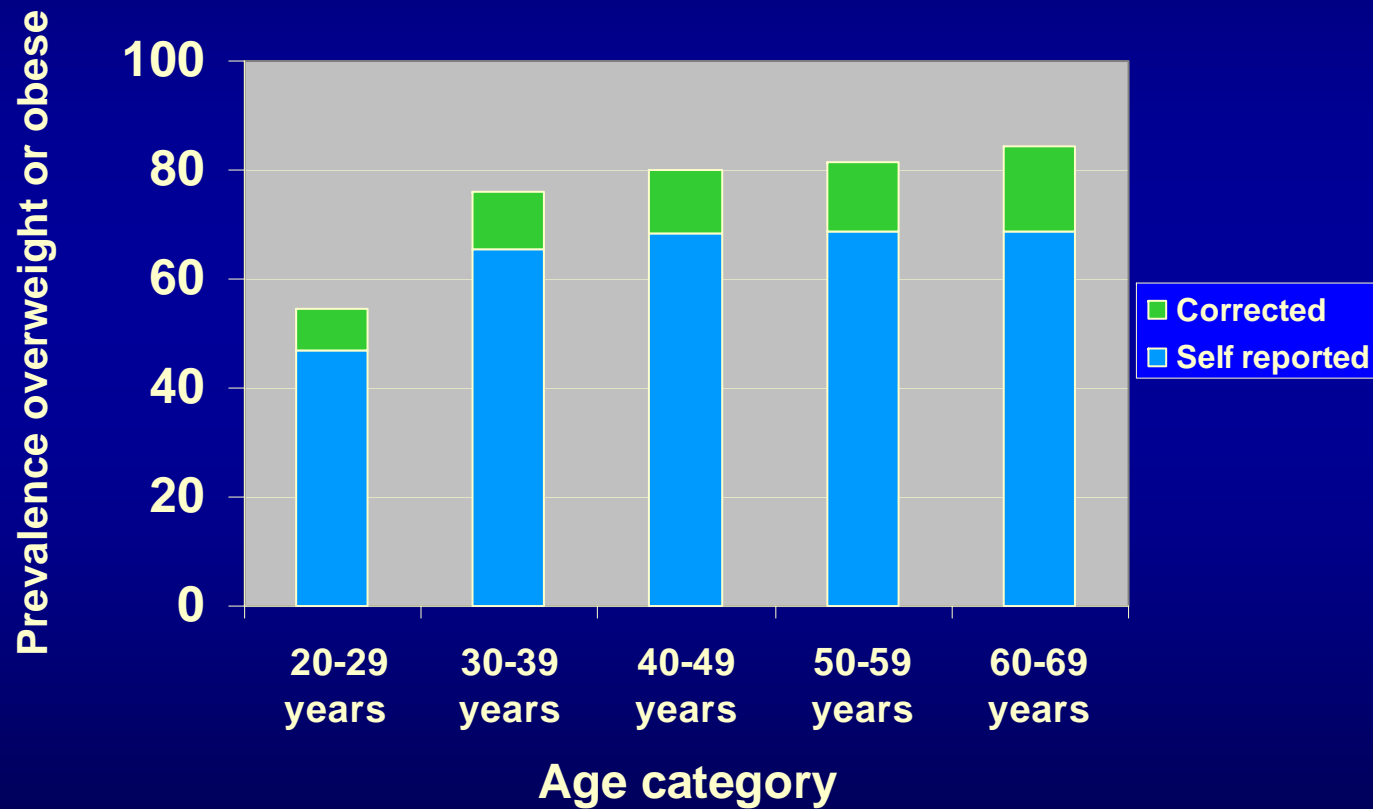


overweight and obesity trends



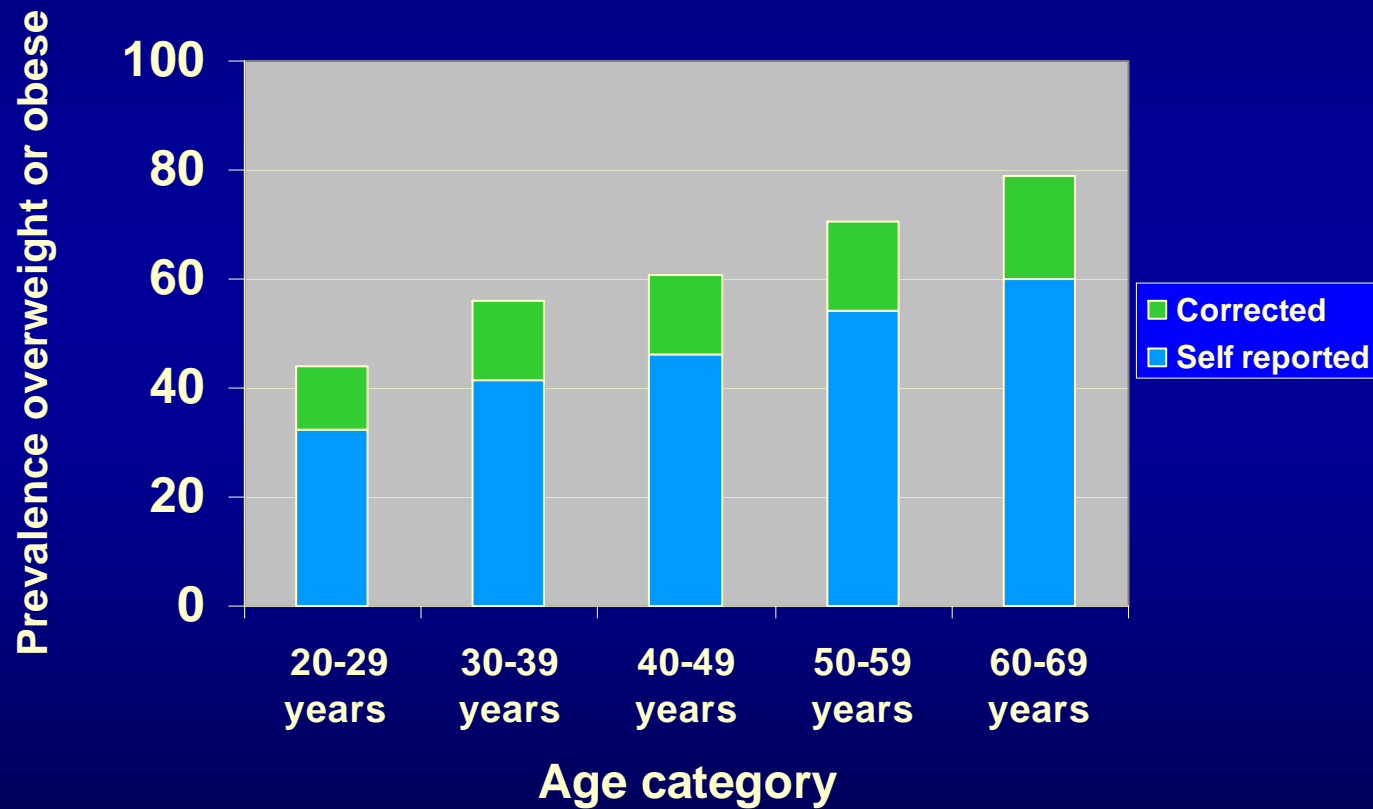


Male overweight and obesity 2005



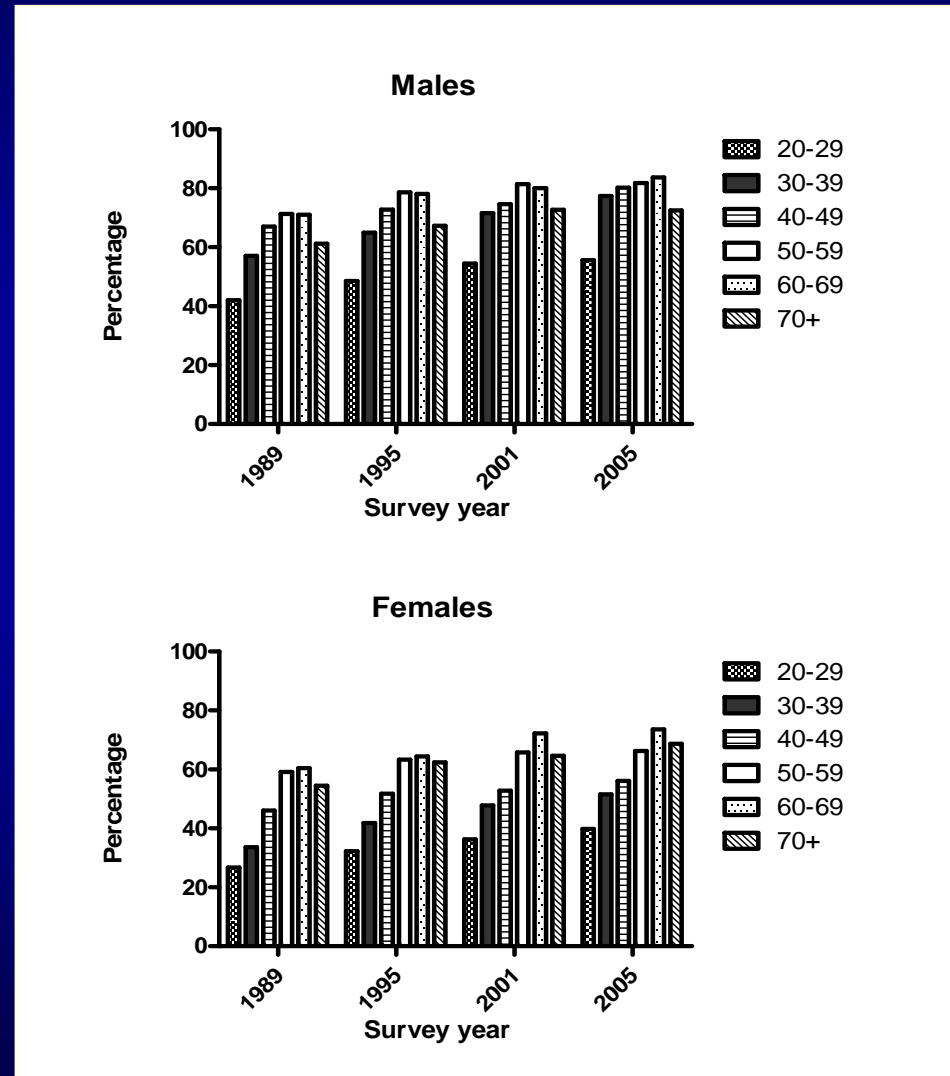


Female overweight and obesity 2005



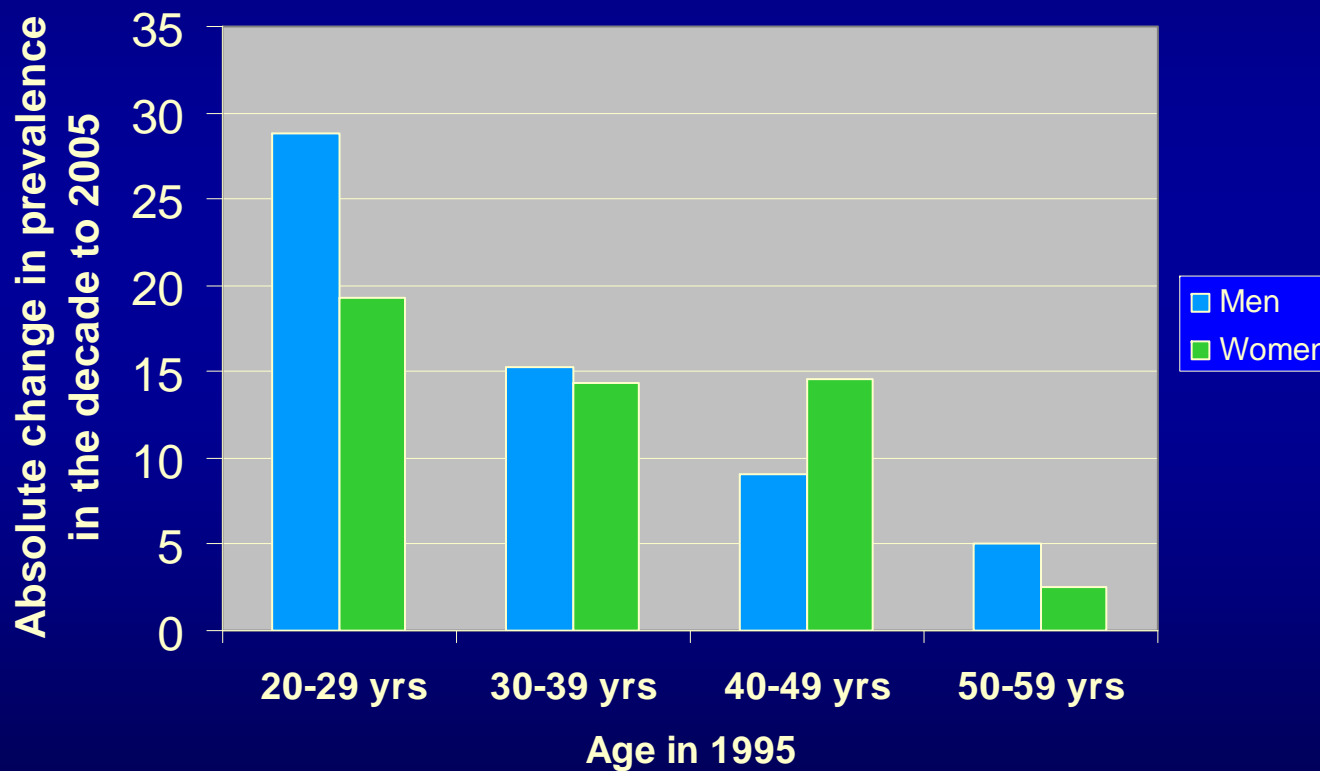


Corrected obesity and overweight by age



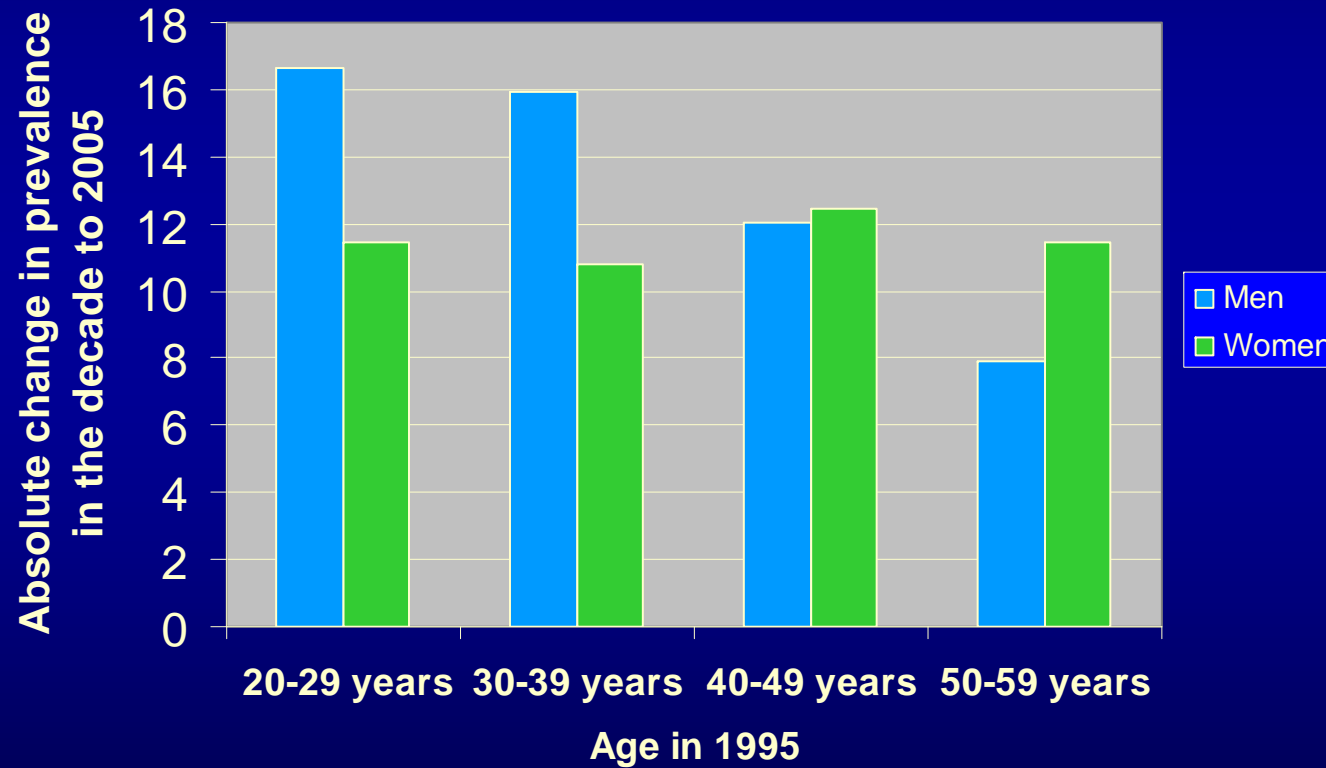


Decade change in overweight and obesity by age cohort



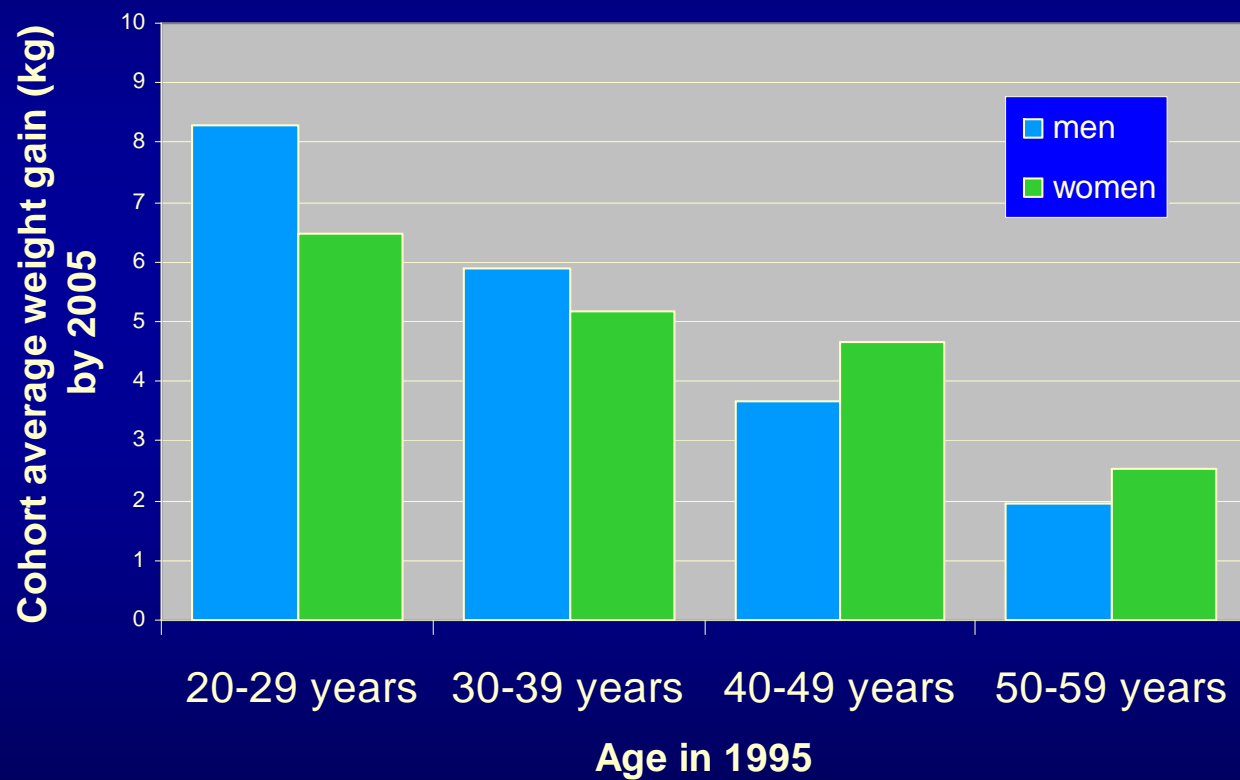


Decade change in obesity by age cohort





Wt gain by age cohort





**“ More than half of adults are
overweight and the numbers are
increasing” : ABS**



Nearly two-thirds

**“~~More than half~~ of adults are
overweight and the numbers are
increasing”** : *Hayes et al ANZJPH*



Conclusions

- Provided algorithms to correct error in self-reported height and weight
- Suggests that almost two thirds of Australians are overweight or obese
- Suggests patterns of weight gain over the lifespan are different for men and women
- Over the last decade greatest weight gain among adults has occurred for men now in their thirties