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**Australian Institute of
Health and Welfare**


Overweight and obesity in Australia: a birth cohort analysis



Overweight and obesity in Australia: a birth cohort analysis



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Abbreviations

- ABS** Australian Bureau of Statistics
AIHW Australian Institute of Health and Welfare
BMI body mass index
WHO World Health Organization

Symbols

- %** per cent
cm centimetres
kg kilograms
kg/m² kilograms per metre squared



Summary

Overweight and obesity is a major public health issue, second only to tobacco smoking as a risk factor contributing to the burden of disease in Australia. This report looks at the prevalence of overweight and obesity by birth cohort to examine potential differences at a given age between people born most recently and those born 4, 8, and 20 years earlier.

Adults in 2014–15 were more likely to be obese than adults of the same age 20 years earlier

Based on body mass index (BMI), adults in 2014–15 were significantly more likely to be obese than those 20 years earlier in all but 1 of the age groups assessed. The largest relative difference across cohorts was at age 18–21—15.2% of those born in 1994–1997 were obese at that age, almost double the proportion of those born in 1974–1977 (8.0%). When broken down by sex, men and women were significantly more likely to be obese at most ages than their counterparts 20 years earlier.

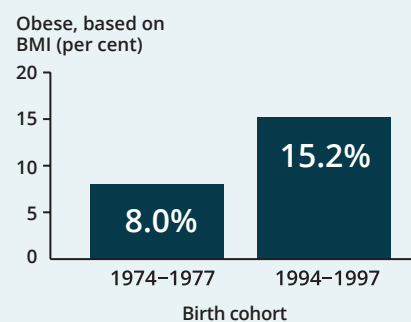
Adults in 2014–15 were more likely to be abdominally obese than adults of the same age 20 years earlier

Based on waist circumference, adults at every age in 2014–15 were significantly more likely to be abdominally obese than those 20 years earlier. The largest relative difference was among adults aged 18–21—16.5% of those born in 1994–1997 were abdominally obese at that age, more than double the proportion of those born in 1974–1977 (7.2%).

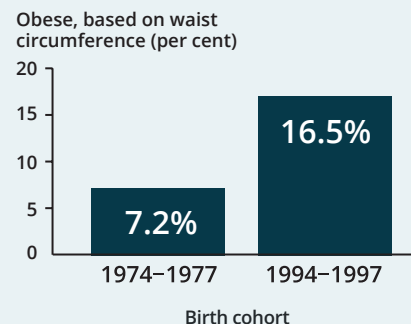
Children and adolescents aged 10–17 in 2014–15 were more likely to be overweight or obese than those 20 years earlier

Based on BMI, children and adolescents in 2014–15 were significantly more likely to be overweight or obese at ages 10–13 and 14–17 than those 20 years earlier. At age 10–13, 30.8% of children and adolescents born in 2002–2005 were overweight or obese, compared with 23.9% of those born in 1982–1985. At age 14–17, 29.8% of adolescents born in 1998–2001 were overweight or obese, compared with 18.7% of those born in 1978–1981. There were no statistically significant differences for overweight and obesity at ages 2–5 and 6–9.

At age 18–21:

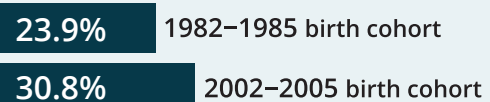


At age 18–21:

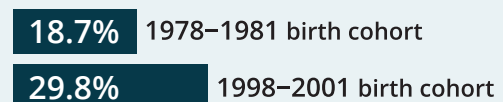


Proportion of overweight and obese children and adolescents:

At age 10–13



At age 14–17



Children aged 2–5 in 2014–15 were twice as likely to be obese than those 20 years earlier

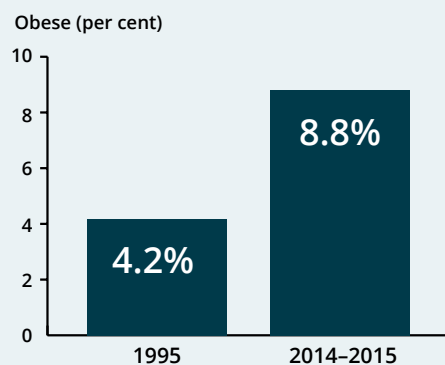
For obesity alone, children at age 2–5 in 2014–15 were significantly more likely to be obese than those 20 years earlier (8.8% compared with 4.2%). There were no statistically significant differences for obesity alone at ages 6–9, 10–13, and 14–17.

When broken down by sex, boys in 2014–15 were significantly more likely to be obese at ages 2–5 and 10–13, compared with those born 20 years earlier. Girls in 2014–15 were significantly more likely to be obese at age 2–5 and 14–17, compared with those born 20 years earlier.

What are the implications?

Given obesity is a risk factor for several chronic conditions, the increased prevalence of obesity at younger ages among those born more recently is likely to be followed by a higher prevalence of obesity-related chronic conditions at younger ages. This will in turn lead to higher health care costs.

Proportion of children who were obese at age 2–5 in:





1

Introduction

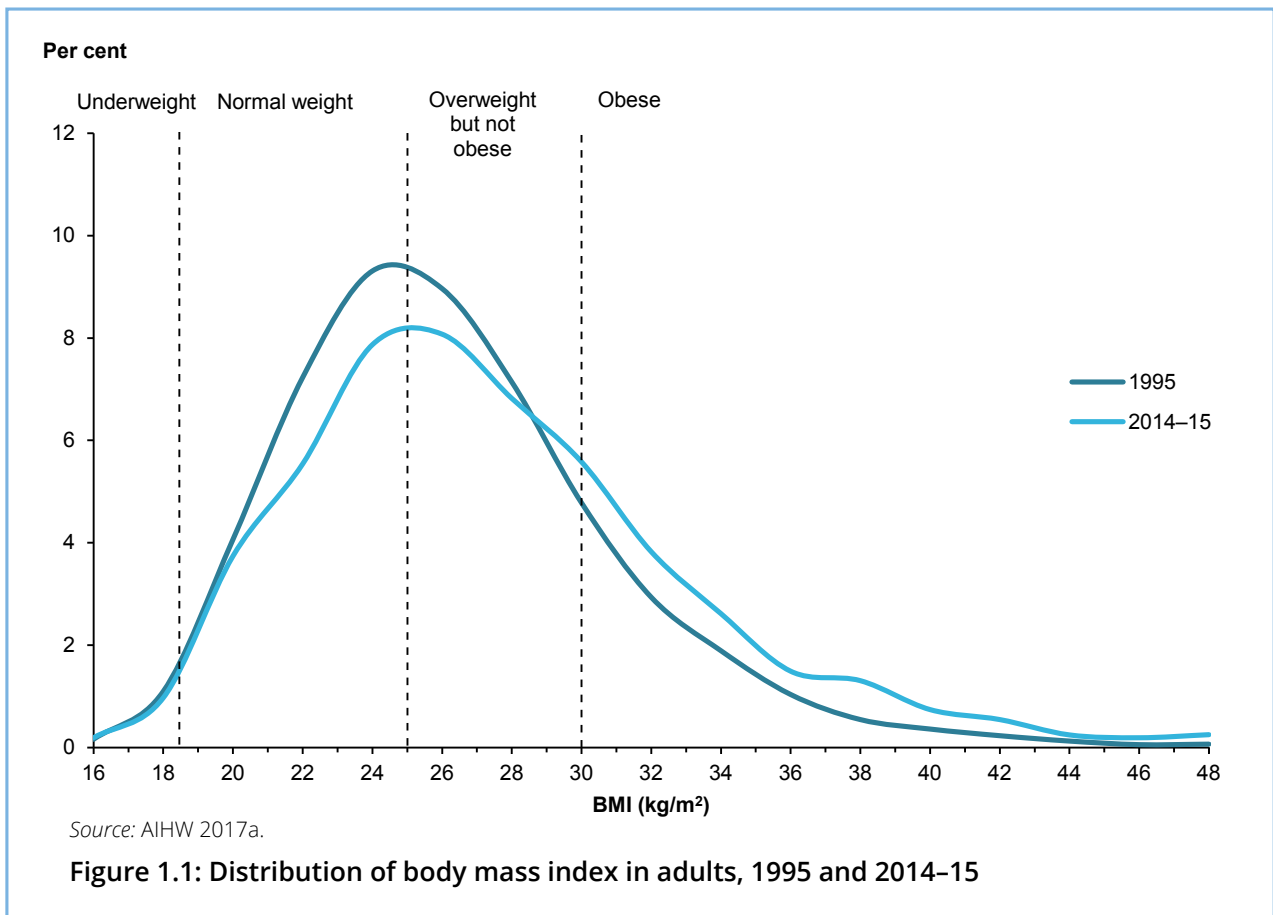
Overweight and obesity is a major public health issue, both globally and in Australia. In 2011, it was the second leading risk factor contributing to the burden of disease in Australia, behind tobacco smoking (AIHW 2016).

Among adults, excess body weight is a risk factor for multiple chronic conditions, including cardiovascular disease, type 2 diabetes, and some cancers. Children and adolescents who are overweight or obese are more likely to become adults who are obese than children and adolescents of a normal weight (Venn et al. 2007).

While both overweight and obesity are risk factors for chronic conditions, being obese is associated with greater health risks than being overweight but not obese. For example, the risks of coronary heart disease, ischaemic stroke, and type 2 diabetes are greater among those who are obese than among those who are overweight but not obese (Bogers et al. 2007; Guh et al. 2009; Strazzullo et al. 2010).

In addition to its health consequences, obesity has substantial economic costs. PwC Australia estimated that obesity cost the Australian economy \$8.6 billion in 2011–12 (in 2014–15 dollars) (PwC Australia 2015). This included an estimated \$3.8 billion in direct costs and \$4.8 billion in indirect costs, but did not account for further costs from reduced wellbeing and forgone earnings. The report estimated that, if no further action is taken to slow the rise in obesity, there will be \$87.7 billion in additional costs due to obesity over a 10-year period (2015–16 to 2024–25).

In Australia, there has been a shift in the population distribution of body mass index (BMI) from 1995 to 2014–15, towards increased prevalence of obesity and higher BMI values. In 2014–15, a smaller proportion of the population were of normal weight, or overweight but not obese, and a greater proportion of the population were obese, compared with 1995 (Figure 1.1). After adjusting for differences in age structure, the overall prevalence of obesity increased among men from 19% in 1995 to 28% in 2014–15 and among women from 19% in 1995 to 27% in 2014–15 (AIHW 2017b).



Data extending further back in time, which is restricted to that from Australian adults living in capital cities, show that the prevalence of obesity also rose from 1980 to 1999–2000. After adjusting for differences in age structure, the prevalence of obesity rose from 9.4% to 16.9% among men, and from 7.9% to 19.8% among women (AIHW: Dixon & Waters 2003).

Two commonly used measures of overweight and obesity are described in Box 1.1.

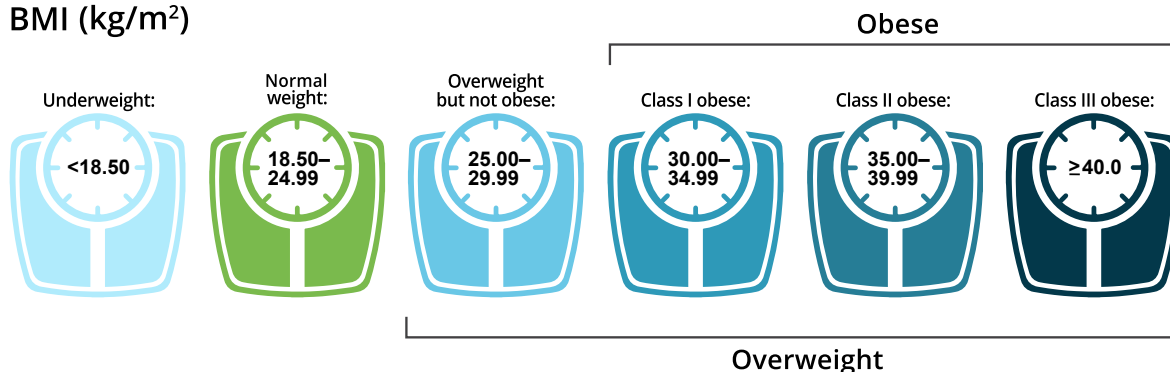
Box 1.1: Measuring overweight and obesity

BMI is a common method of assessing whether a person is underweight, normal weight, overweight or obese. BMI is calculated by dividing a person's weight (in kilograms) by their height (in metres) squared.

$$\text{BMI} = \frac{\text{weight in kg}}{(\text{height in m})^2}$$

This report uses the BMI classifications for adults defined by the World Health Organization (WHO). Obesity is split into 3 classes according to severity, with more severe obesity associated with a higher risk of comorbidities (WHO 2000).

BMI (kg/m²)



The classification of overweight and obesity among children and adolescents is more complicated, due to their growing bodies (WHO 2000). Because of this, age-and sex-specific BMI cut-off points have been developed to classify children and adolescents as underweight, normal weight, overweight but not obese, or obese (Cole et al. 2000).

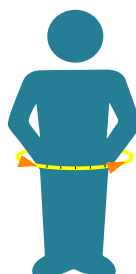
While BMI is a useful population-level measure of overweight and obesity, differences in body composition mean that different cut-off points might need to be considered for certain population groups, such as older adults, people with high muscle mass, Aboriginal and Torres Strait Islander people, and Pacific Islander, South Asian, Chinese, and Japanese populations (NHMRC 2013).

Waist circumference is another commonly used measure of overweight and obesity. A wider waist is associated with a higher risk of metabolic complications. The following waist circumference classifications for Caucasian adults were developed by the WHO.

Waist circumference

Increased risk of metabolic complications

Men: 94 cm or more
Women: 80 cm or more



Substantially increased risk of metabolic complications

Men: 102 cm or more
Women: 88 cm or more

Different waist circumference cut-off points might need to be considered for certain population groups, such as South Asian, Chinese, and Japanese populations (NHMRC 2013).

Previous analyses in Australia and internationally have shown that the prevalence of obesity varies by birth cohort (a group of people born in the same year or years—the experiences of people in a particular birth cohort can be different to those of people in other birth cohorts).

Analyses of Australian data have found that the prevalence of obesity was greater among birth cohorts born more recently than among those born earlier, when comparing birth cohorts at the same age (AIHW: Bennett et al. 2004; Allman-Farinelli et al. 2008; Pilkington et al. 2014).

The potential implications of increased prevalence of obesity at younger ages are earlier onset of obesity-related chronic conditions, higher health-care costs, impacts on workforce productivity and a greater prevalence of obesity later in life. A higher number of years lived with obesity is also associated with increased risk of mortality (Abdullah et al. 2011).

Analysis by birth cohort might also expose changes in the prevalence of overweight and obesity at specific ages that are masked when looking at the overall prevalence of overweight and obesity.

This report looks at how the prevalence of overweight and obesity varies by birth cohort, using the most recent national-level data. These data have not been included in previous analyses, and enable the inclusion of birth cohorts born more recently.

The report uses national survey data from 4 surveys conducted from 1995 to 2014–15 to construct birth cohorts. It then compares the prevalence of overweight and obesity among different birth cohorts at the same ages, and looks at changes in the prevalence of overweight and obesity among birth cohorts as they age.

The birth cohorts range from people born in 1930–1933 to people born in 2010–2013.

This report has 4 chapters:

- This **introductory chapter** provided background information on overweight and obesity, and birth cohorts.
- **Chapter 2** covers the methods used in this report, and includes information on the data sources used.
- **Chapter 3** details the results of the analysis.
- **Chapter 4** provides a discussion of the results.

Supplementary tables (Table S1–S6) of the data underlying the figures and text in this report (including prevalence estimates, confidence intervals, and the results of significance testing) are available at <<https://www.aihw.gov.au/reports/overweight-obesity/overweight-obesity-australia-birth-cohort-analysis/data>>.

2

Methods

A brief overview of the data sources and methods used in this report is provided in this chapter. Detailed information is provided in 'Appendix A'.

Data sources

The analyses presented in this report are based on data collected in the following national cross-sectional surveys conducted by the Australian Bureau of Statistics (ABS):

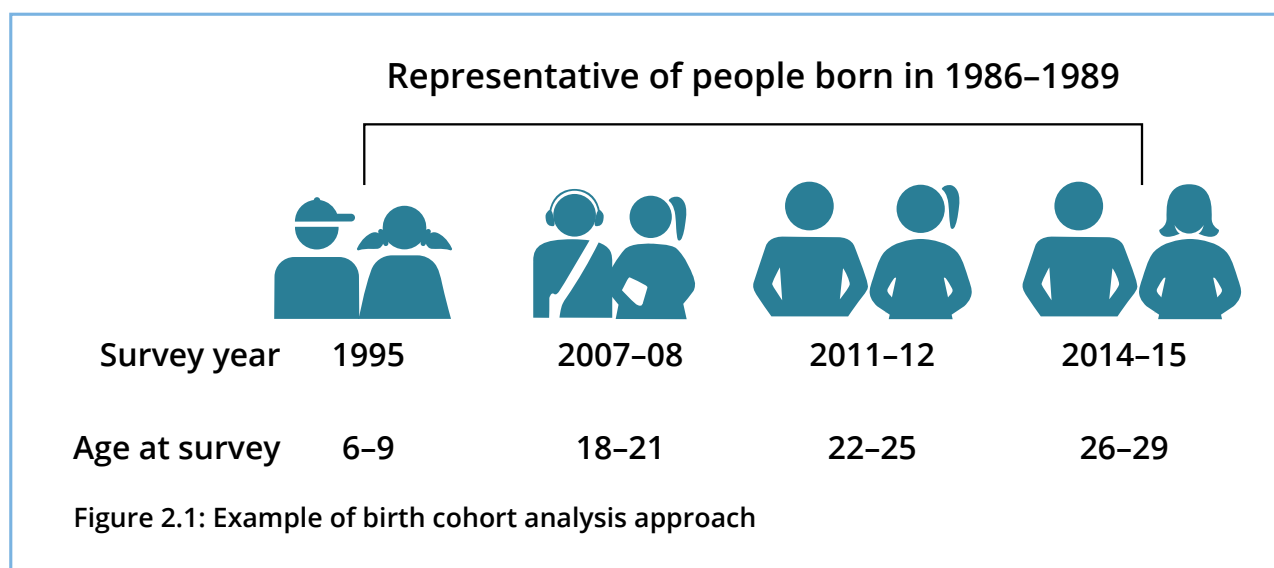
- 1995 National Nutrition Survey
- 2007–08 National Health Survey
- 2011–12 Australian Health Survey
- 2014–15 National Health Survey.

These data sources were chosen because they provided measured height, weight, and waist circumference data at the national level.

Methods

This report did not track the same individuals over time. Rather, birth cohorts were constructed using cross-sectional survey data representing the Australian population in 1995, 2007–08, 2011–12, and 2014–15.

This approach treats, for example, survey participants aged 6–9 in 1995, and survey participants aged 26–29 in 2014–15 as representative of the same group of people (those born in 1986–1989) as they age 20 years between the surveys (Figure 2.1).



For each birth cohort, at each survey year, several measures were calculated for total persons and by sex. These were the percentage of birth cohort who were:

- overweight or obese, based on BMI
- obese, based on BMI
- severely obese, based on BMI (for adults only)
- abdominally obese, based on waist circumference (for adults only).

For children and adolescents, age- and sex-specific half-year BMI cut-off points were used (Cole et al. 2000).

For adults:

- overweight and obesity was classified as a BMI of 25.00 kg/m² or more
- obesity was classified as a BMI of 30.00 kg/m² or more
- severe obesity was used to describe the combined prevalence of class II and class III obesity— class II obesity was classified as a BMI of 35.00 kg/m² to 39.99 kg/m², while class III obesity was classified as a BMI of 40.00 kg/m² or more
- abdominal obesity was classified as a waist circumference of 102 cm or more for men, and of 88 cm or more for women.

The statistical significance of the difference in prevalence estimates at each age between people in the birth cohort born most recently and those born 4, 8, and 20 years earlier was assessed using z scores. For further details, see 'Significance testing' in 'Appendix A'.

3

Results

This chapter presents the results of analysis for:

- children and adolescents (aged 2–17) on:
 - overweight and obesity
 - obesity alone
- adults (aged 18–65) on:
 - overweight and obesity
 - obesity alone
 - severe obesity
 - abdominal obesity.

Two styles of charts are used in this chapter—line charts and column charts. The line charts show change in prevalence of overweight and obesity, obesity alone, severe obesity, and abdominal obesity with age among each birth cohort. The bar charts show the prevalence of overweight and obesity, obesity alone, severe obesity, and abdominal obesity by age group and survey. They can be used to compare estimates of prevalence at a specific age group between surveys, and therefore between birth cohorts.

As the prevalence of each measure—overweight and obesity, obesity alone, severe obesity, and abdominal obesity—varies, so too does the scale between figures. Care should be taken when comparing figures with different scales.

Supplementary tables (Table S1–S6) of the data underlying the figures and text in this report (including prevalence estimates, confidence intervals, and the results of significance testing) are available at <<https://www.aihw.gov.au/reports/overweight-obesity/overweight-obesity-australia-birth-cohort-analysis/data>>.

Children and adolescents

Overweight and obesity

Figure 3.1 shows how the prevalence of overweight and obesity changed with age in childhood and adolescence among each birth cohort.

Those born in 1990–1993 can be followed as they aged from 2–5 to 14–17. The prevalence of overweight and obesity among this birth cohort rose significantly, from 19.9% at age 2–5 to 28.0% at age 14–17.

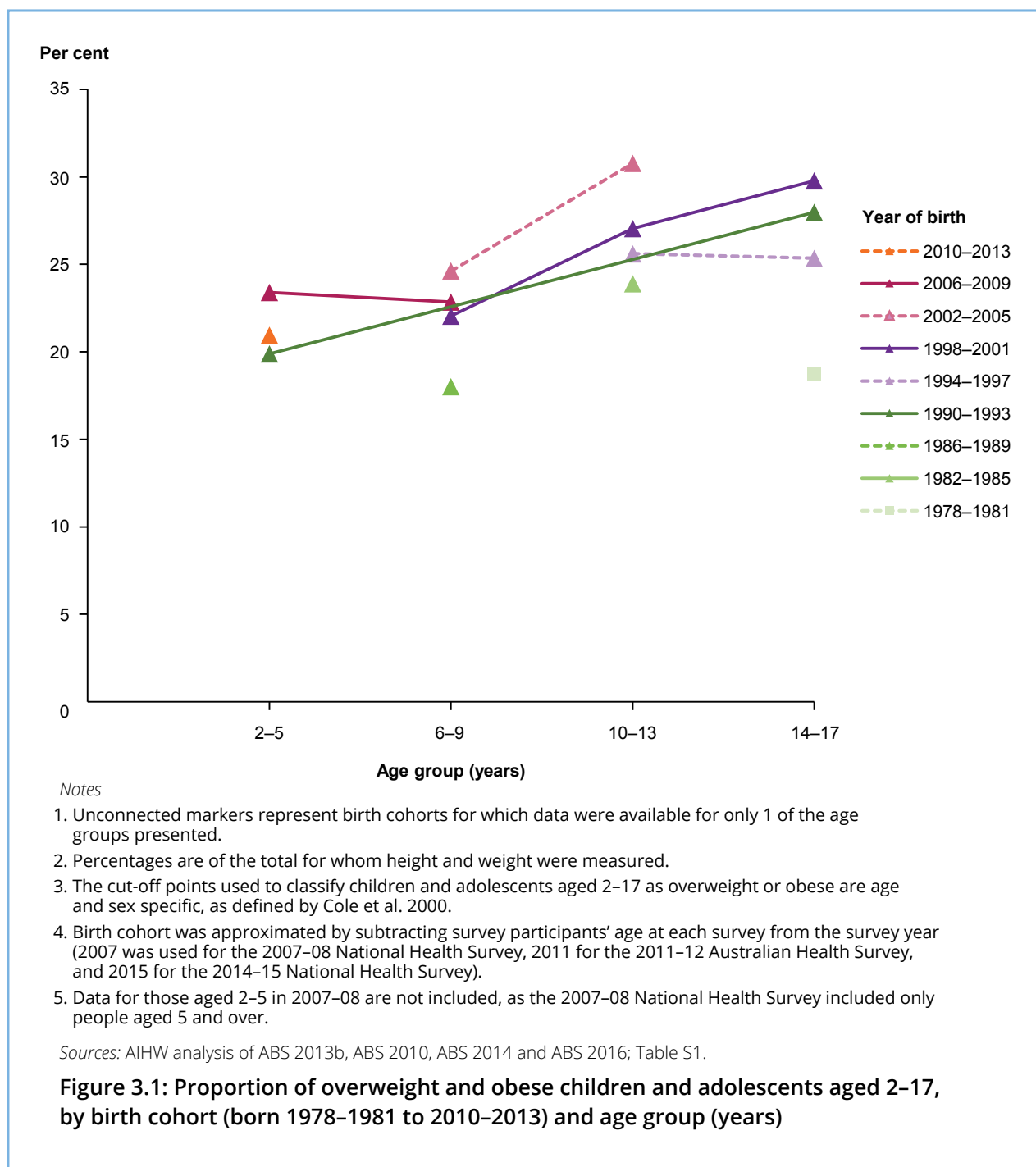
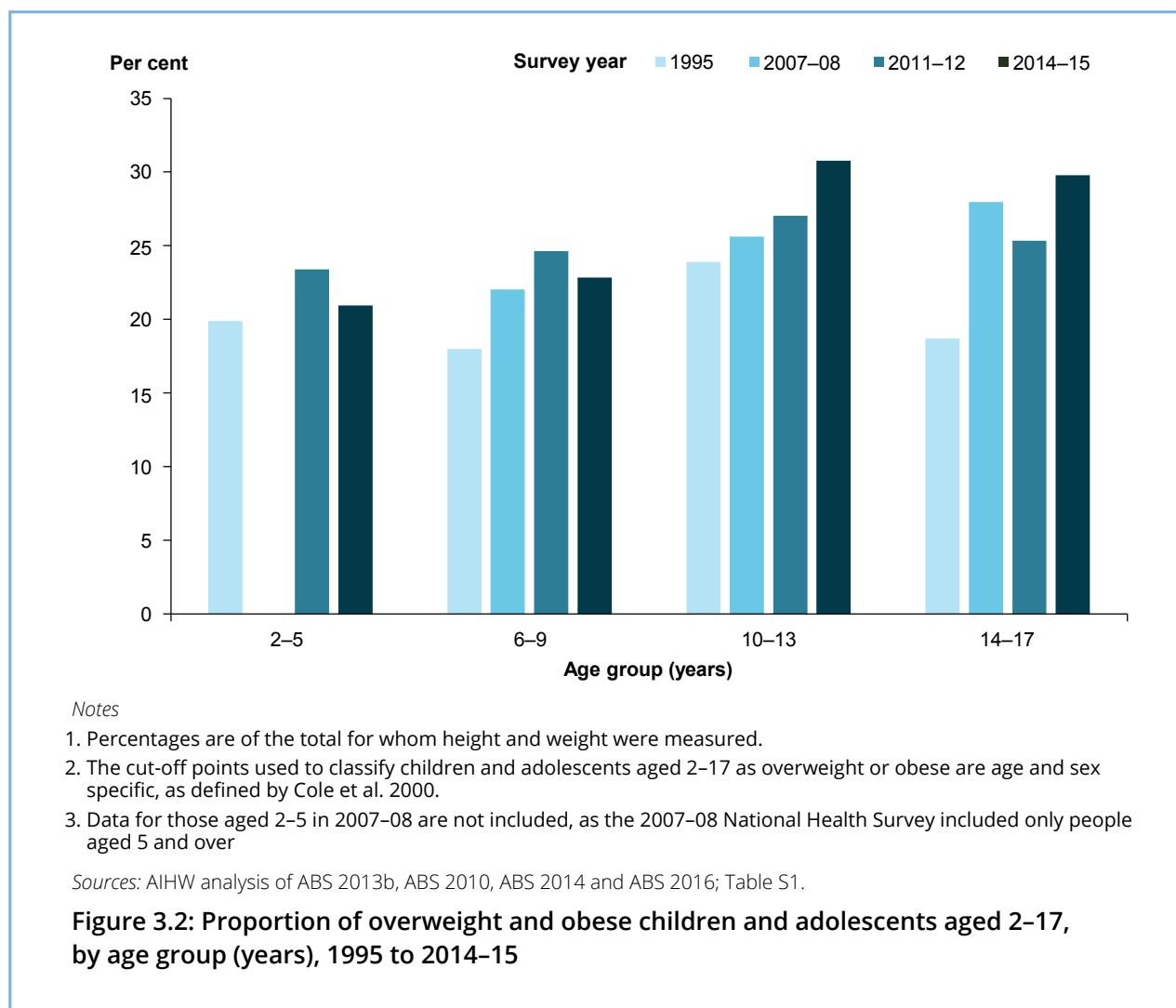


Figure 3.2 shows another way of looking at the data shown in Figure 3.1. It shows the prevalence of overweight and obesity among each age group at each of the 4 surveys.

At ages 10–13 and 14–17, the prevalence of overweight and obesity was significantly higher in 2014–15 than in 1995 (Table S1). Put another way, children and adolescents in the birth cohort born most recently at ages 10–13 and 14–17 (measured in 2014–15) were significantly more likely to be overweight or obese than children and adolescents born 20 years earlier (measured in 1995). At ages 2–5 and 6–9, the difference between 1995 and 2014–15 was not statistically significant.

At all child and adolescent ages, the difference in the prevalence of overweight and obesity between 2007–08 and 2014–15, and between 2011–12 and 2014–15 was not statistically significant.



There were some differences when broken down by sex. Among boys, those in the birth cohort born most recently were significantly more likely to be overweight or obese at 6–9, 10–13, and 14–17 than boys born 20 years earlier (Table S1). At age 10–13, boys in the birth cohort born most recently were significantly more likely to be overweight or obese than those born 4 or 8 years earlier.

Among girls, those in the birth cohort born most recently were significantly more likely to be overweight or obese only at age 14–17 than those born 20 years earlier. There were no other statistically significant differences in the prevalence of overweight and obesity among girls.

Obesity

Figure 3.3 shows how the prevalence of obesity changed with age in childhood and adolescence among each birth cohort.

Those born in 1990–1993 can be followed as they aged from 2–5 to 14–17. The prevalence of obesity among this birth cohort rose significantly, from 4.2% at age 2–5 to 9.5% at age 14–17.

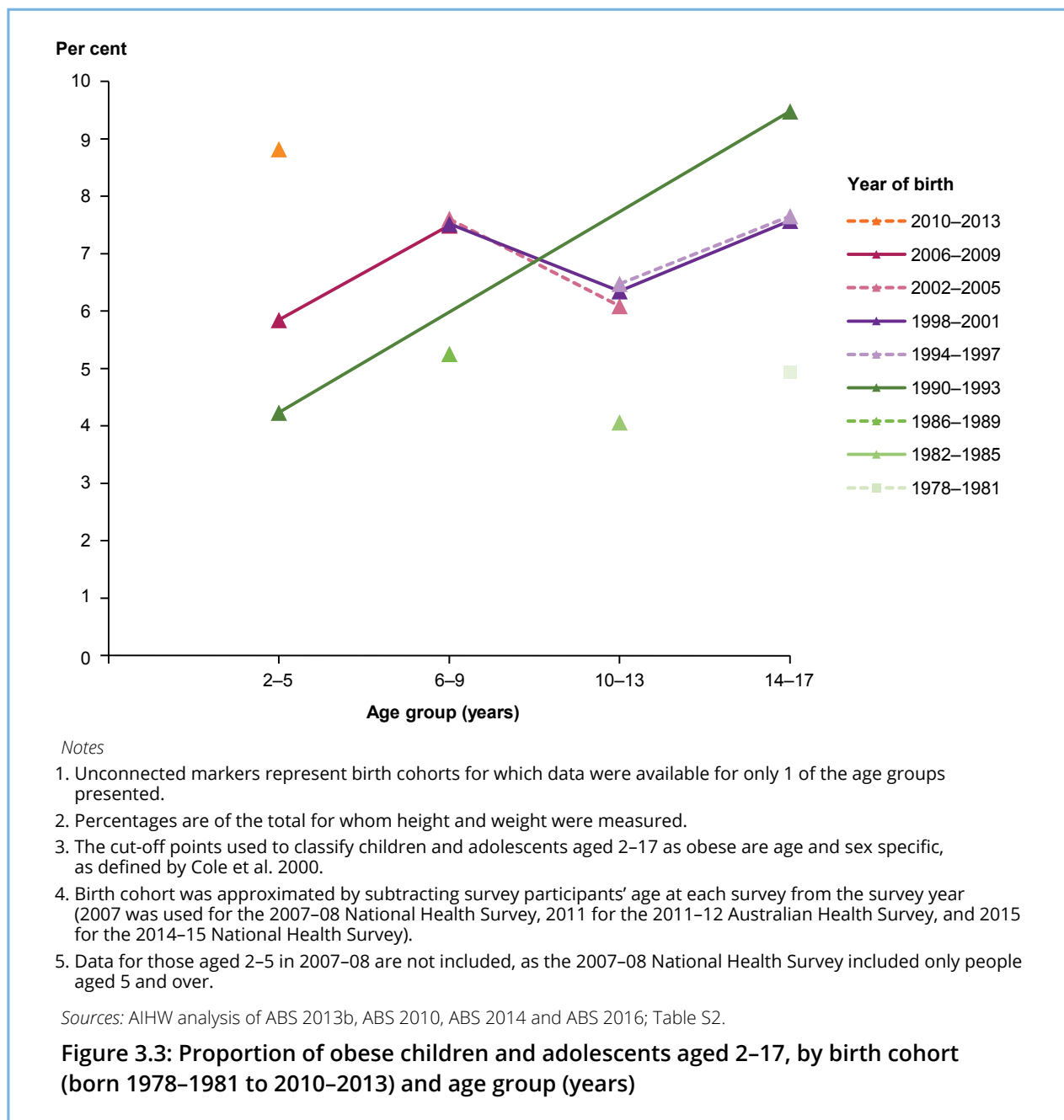
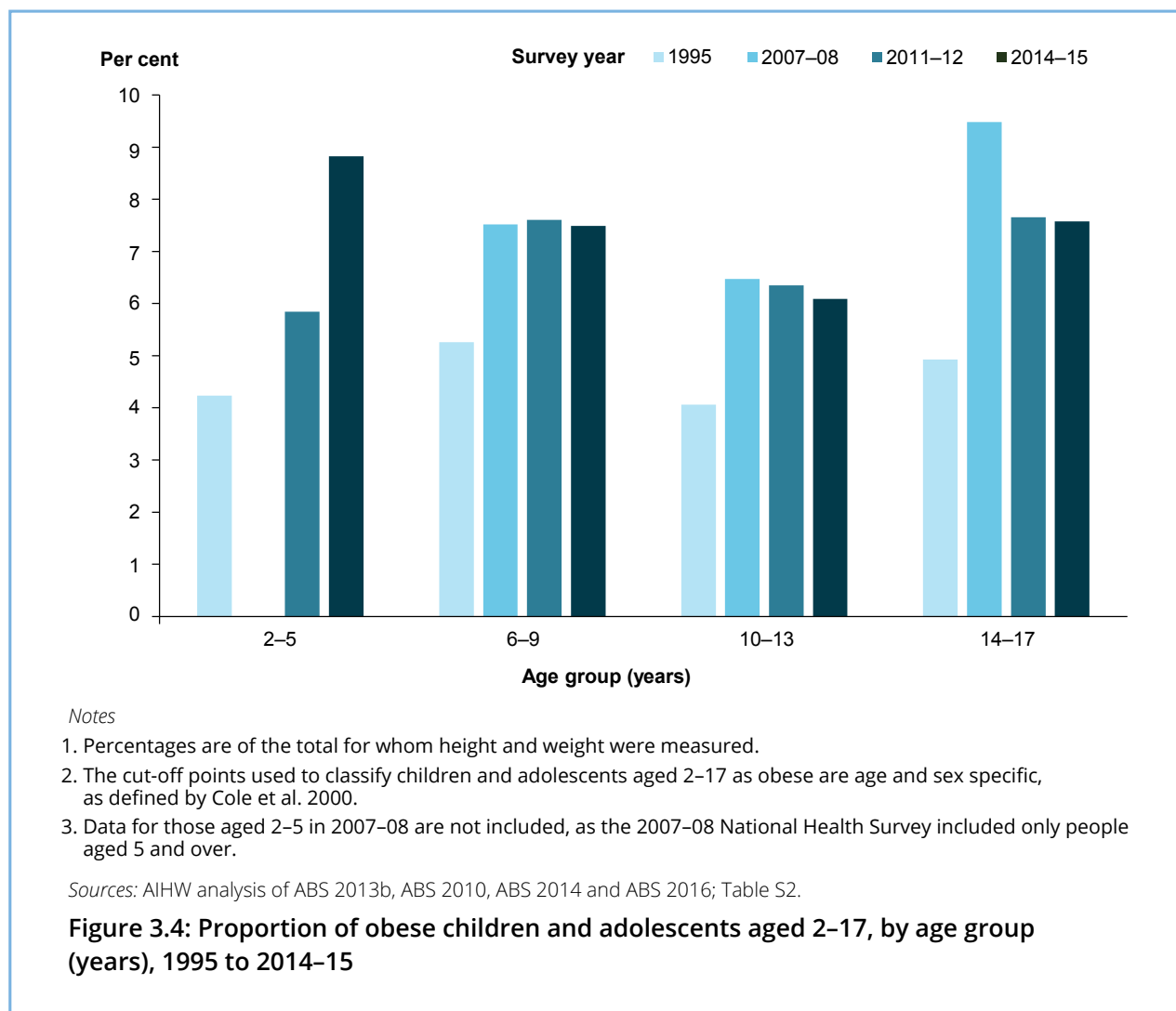


Figure 3.4 shows another way of looking at the data shown in Figure 3.3. It shows the prevalence of obesity among each age group at each of the 4 surveys.

Although the prevalence of obesity at each age between 2014–15 and 1995, 2007–08, and 2011–12 varied, only 1 of these differences was statistically significant for all children (Table S2).

At age 2–5, 8.8% of children in 2014–15 were obese, compared with 4.2% of children in 1995. Put another way, 8.8% of children born in 2010–2013 (measured in 2014–15) were obese at age 2–5, compared with 4.2% of children born in 1990–1993 (measured in 1995).



When broken down by sex, there were statistically significant differences at other ages. Among boys, those in the birth cohort born most recently were significantly more likely to be obese at ages 2–5 and 10–13 than boys born 20 years earlier (Table S2). In comparison, at age 14–17, boys in the birth cohort born most recently were significantly less likely to be obese than those born 8 years earlier.

Among girls, those in the birth cohort born most recently were significantly more likely to be obese at ages 2–5 and 14–17 than girls born 20 years earlier. There were no other statistically significant differences in the prevalence of obesity among girls.

It should be noted that some sex-specific prevalence estimates had a relative standard error of between 25% and 50%, and should be used with caution (see 'Appendix A'). For more details, see Table S2.

Adults

Overweight and obesity

Figure 3.5 shows how the prevalence of overweight and obesity among adults changed with age among each birth cohort.

The birth cohorts born from 1950–1953 through to 1974–1977 can be followed over 20 years. For each of these birth cohorts, the prevalence of overweight and obesity rose significantly as they aged 20 years. For example, for those born in 1974–1977, the prevalence of overweight and obesity more than doubled with age, from 27.8% at age 18–21 to 64.3% at age 38–41.

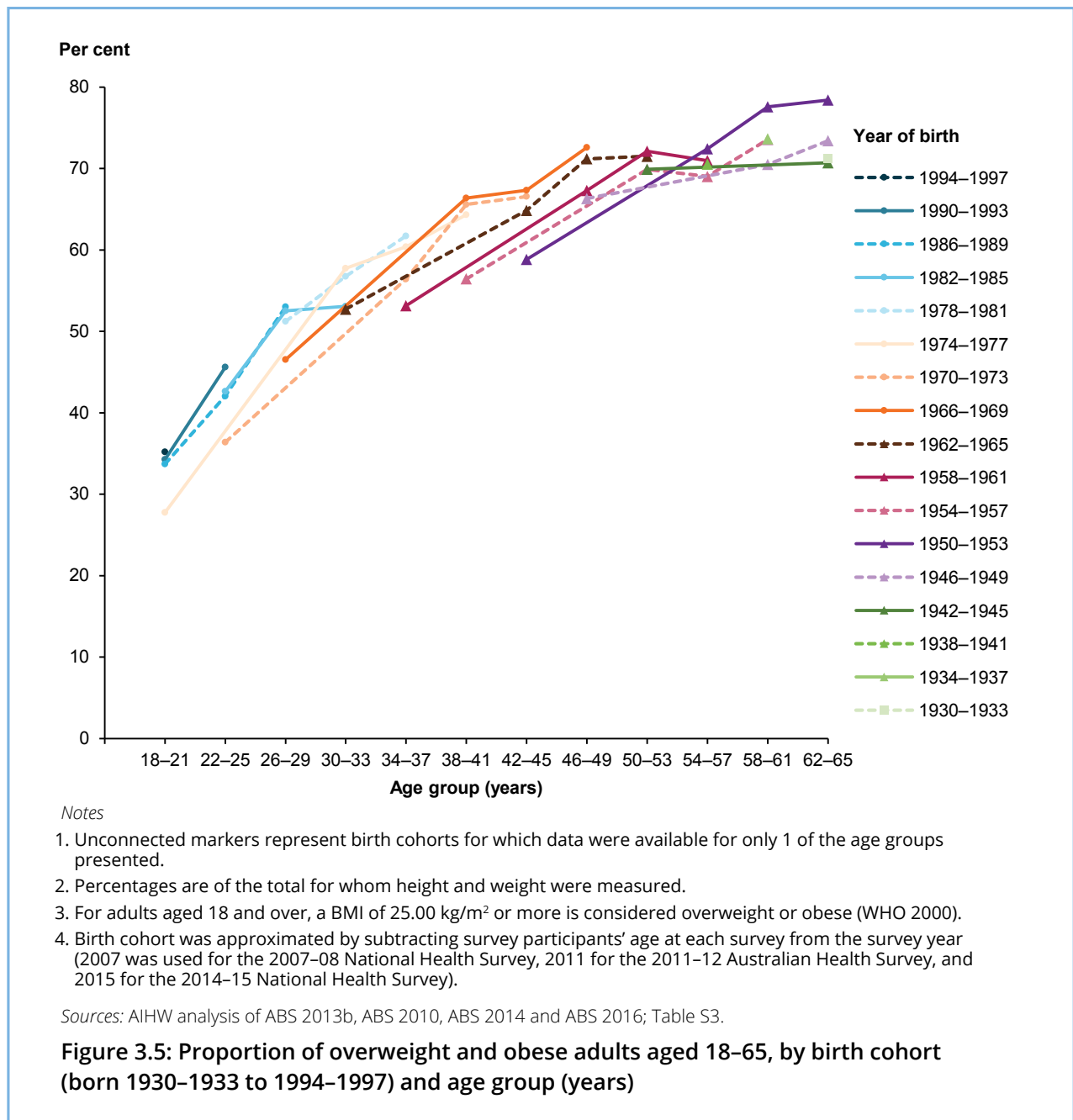
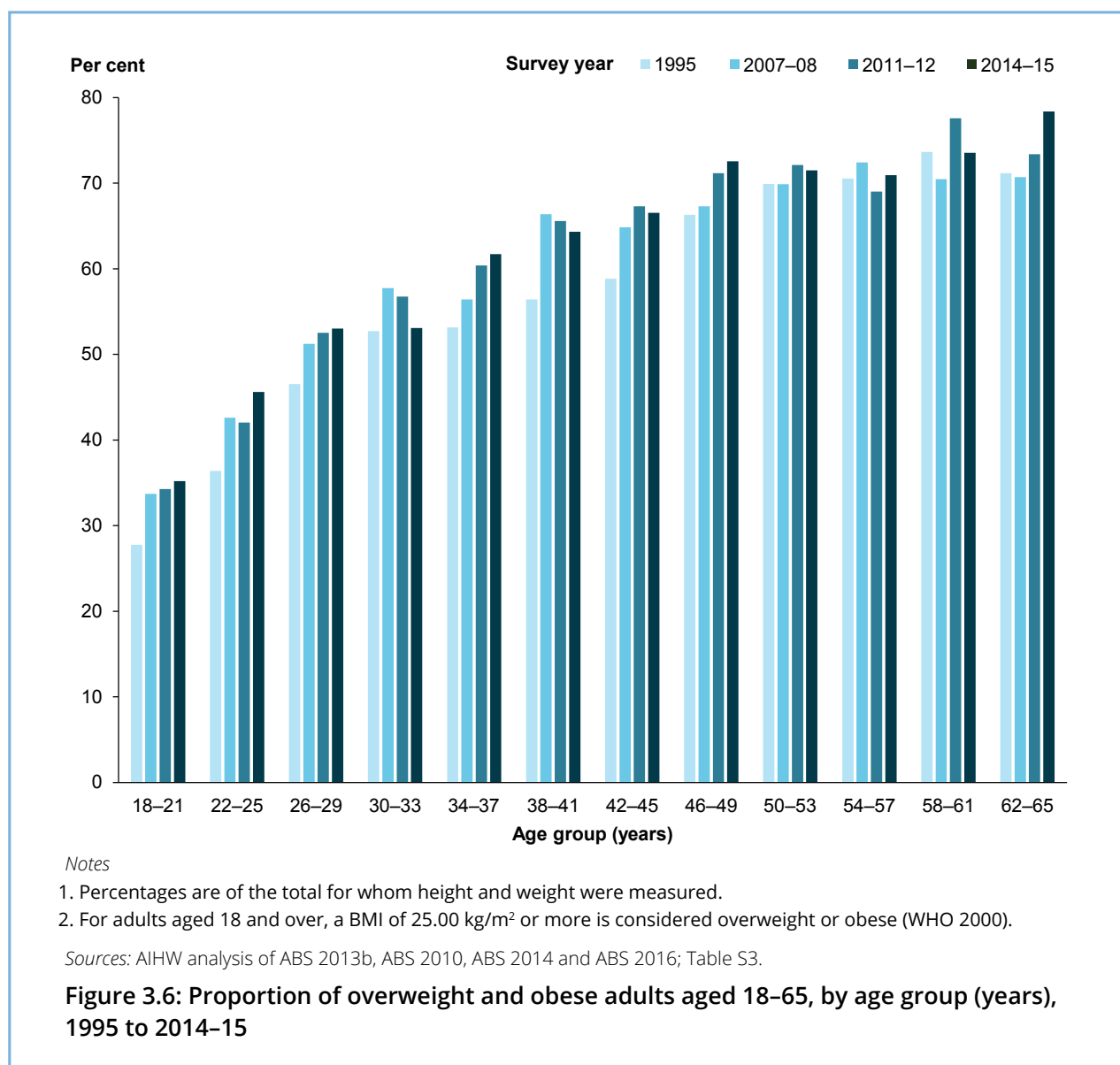


Figure 3.6 shows another way of looking at the data shown in Figure 3.5. It shows the prevalence of overweight and obesity among each age group at each of the 4 surveys.

At most adult ages (except ages 30–33, and 50–53 through to 58–61), the prevalence of overweight and obesity was significantly higher in 2014–15 than in 1995 (Table S3).

Put another way, those in the birth cohort born most recently at these ages (measured in 2014–15) were significantly more likely to be overweight or obese than those born 20 years earlier (measured in 1995). The largest relative difference was at age 18–21, where 35.2% of those born in 1994–1997 were overweight or obese, compared with 27.8% of those born in 1974–1977.

The prevalence of overweight and obesity was significantly higher in 2014–15 than in 2007–08 for those aged 46–49 (72.6% compared with 67.3%), and 62–65 (78.4% compared with 70.7%). At age 62–65, the prevalence of overweight and obesity was significantly higher in 2014–15 than in 2011–12.



When broken down by sex, there were some differences between men and women. Men in the birth cohort born most recently were significantly more likely to be overweight or obese at ages 18–21, 26–29, 38–41, and 62–65 than those born 20 years earlier. Women in the birth cohort born most recently were significantly more likely to be overweight or obese at ages 22–25, 26–29, 34–37, and 46–49 than those born 20 years earlier (Table S3).

There were few statistically significant differences in the prevalence of overweight and obesity between men born most recently and those born 4 or 8 years earlier, and no statistically significant differences for women.

Obesity

Figure 3.7 shows how the prevalence of obesity among adults changed with age among each birth cohort. Those born from 1950–1953 through to 1974–1977 can be followed over 20 years. For each of these birth cohorts, the prevalence of obesity increased significantly as they aged 20 years. For example, for those born in 1974–1977, the prevalence of obesity more than tripled with age, from 8.0% at age 18–21 to 28.7% at age 38–41.

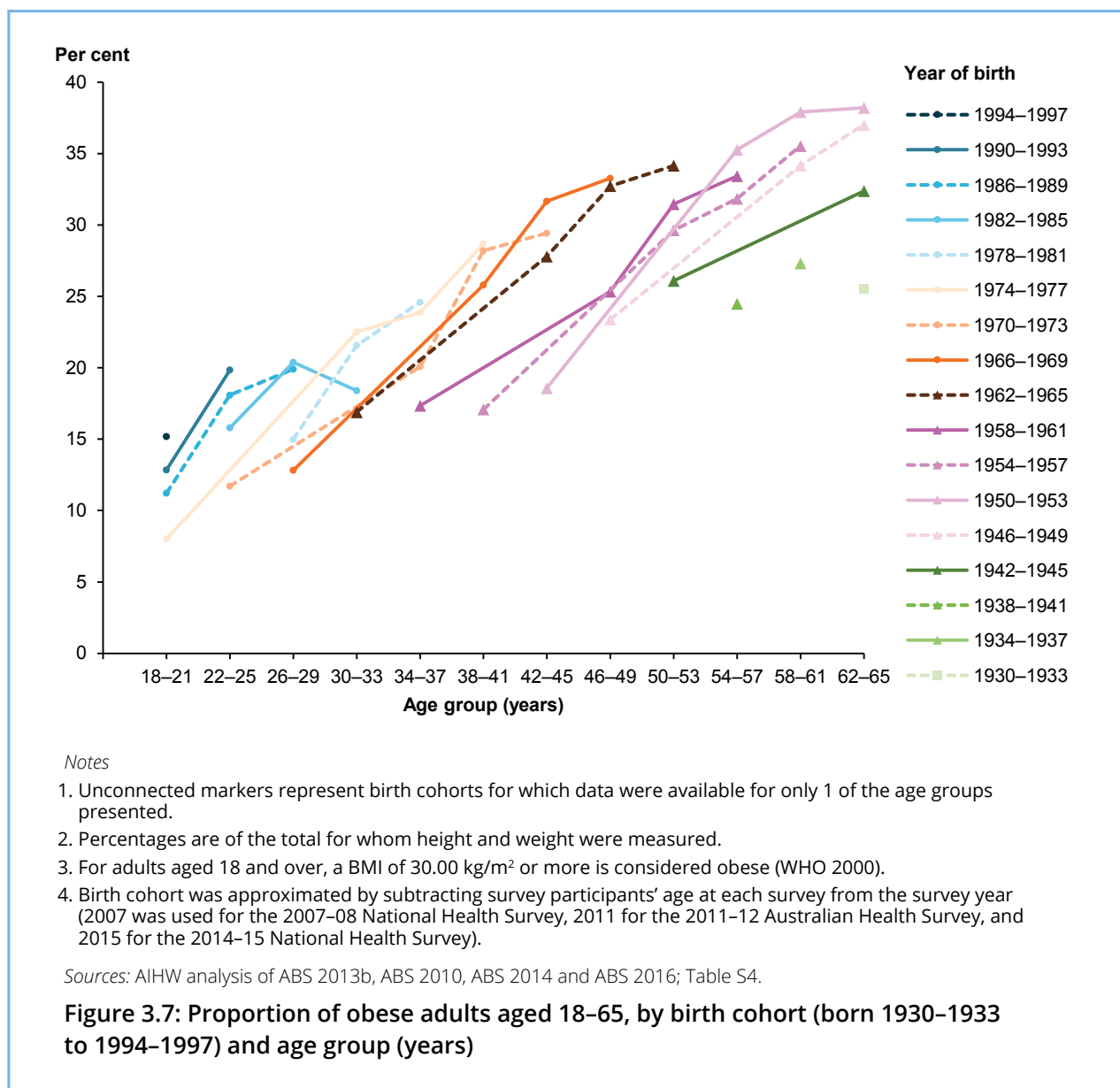
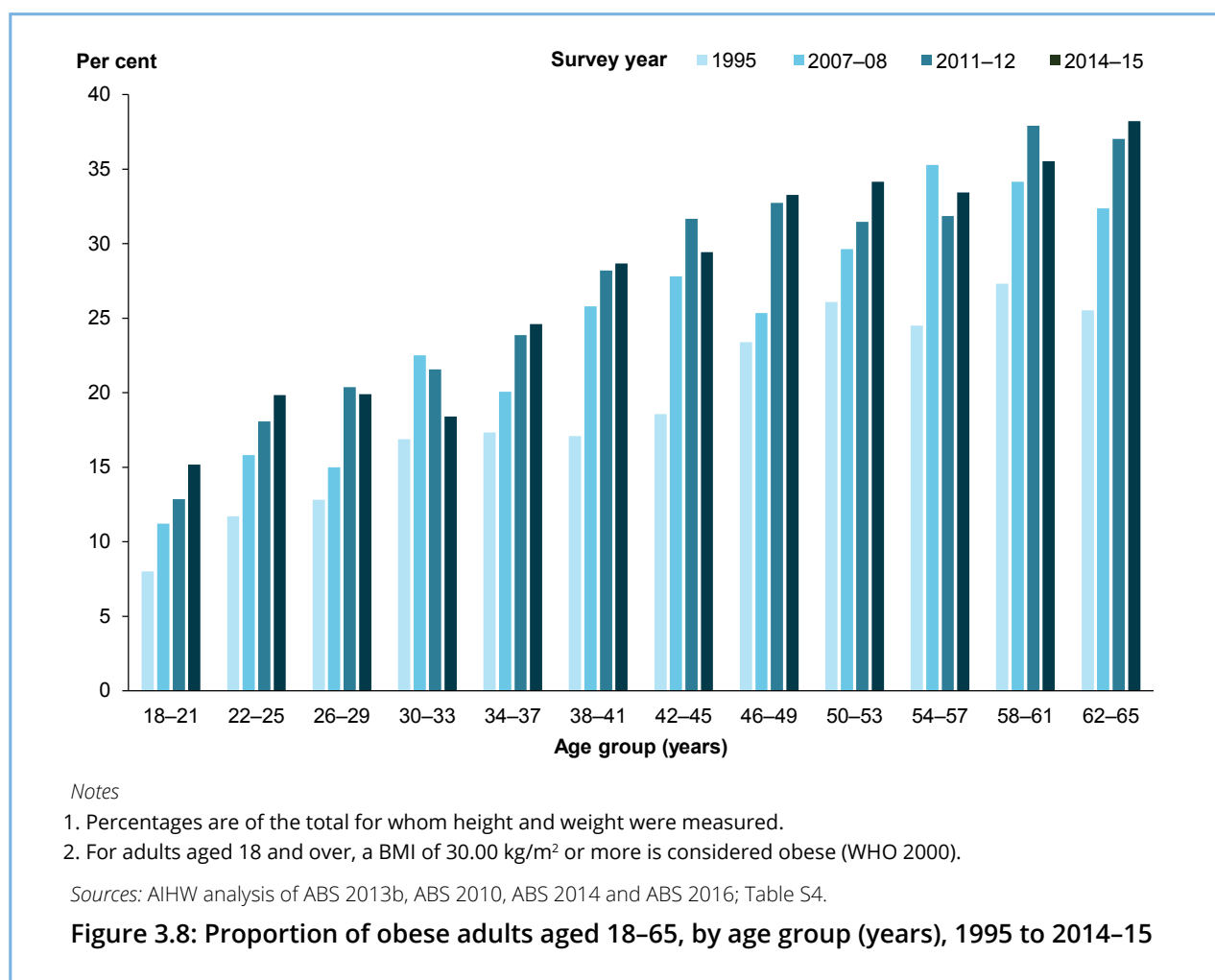


Figure 3.8 shows another way of looking at the data shown in Figure 3.7. It shows the prevalence of obesity among each age group at each of the 4 surveys.

At all adult ages except 30–33, the prevalence of obesity was significantly higher in 2014–15 than in 1995 (Table S4). Put another way, those in the birth cohort born most recently at each age (measured in 2014–15) were significantly more likely to be obese than those born 20 years earlier (measured in 1995).

The largest relative difference was at age 18–21, where 15.2% of those born in 1994–1997 were obese compared with 8.0% of those born in 1974–1977.

At ages 46–49 and 62–65, the prevalence of obesity was significantly higher in 2014–15 than in 2007–08. There were no statistically significant differences at the remaining adult ages between 2007–08 and 2014–15, nor at all adult ages between 2011–12 and 2014–15.

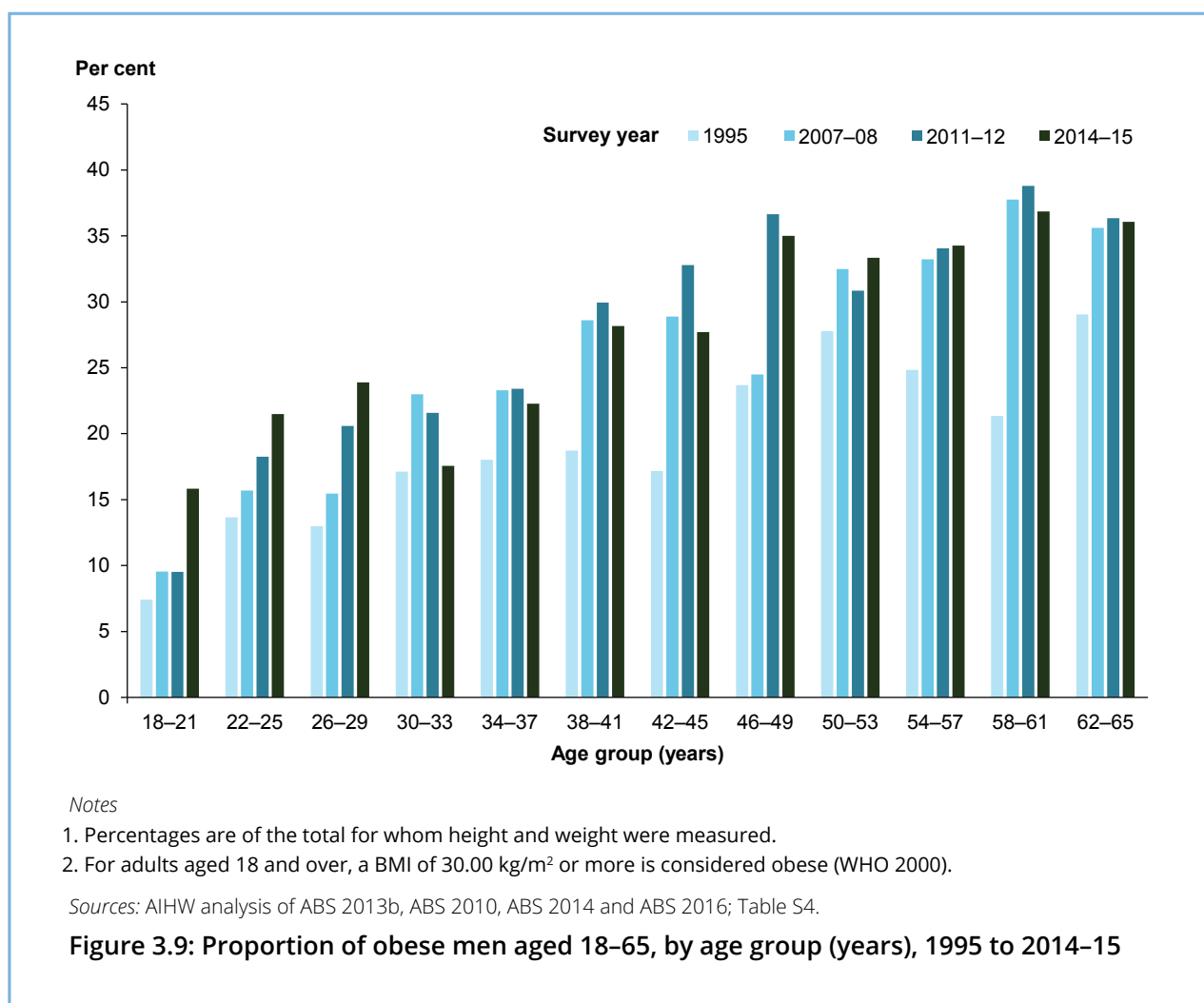


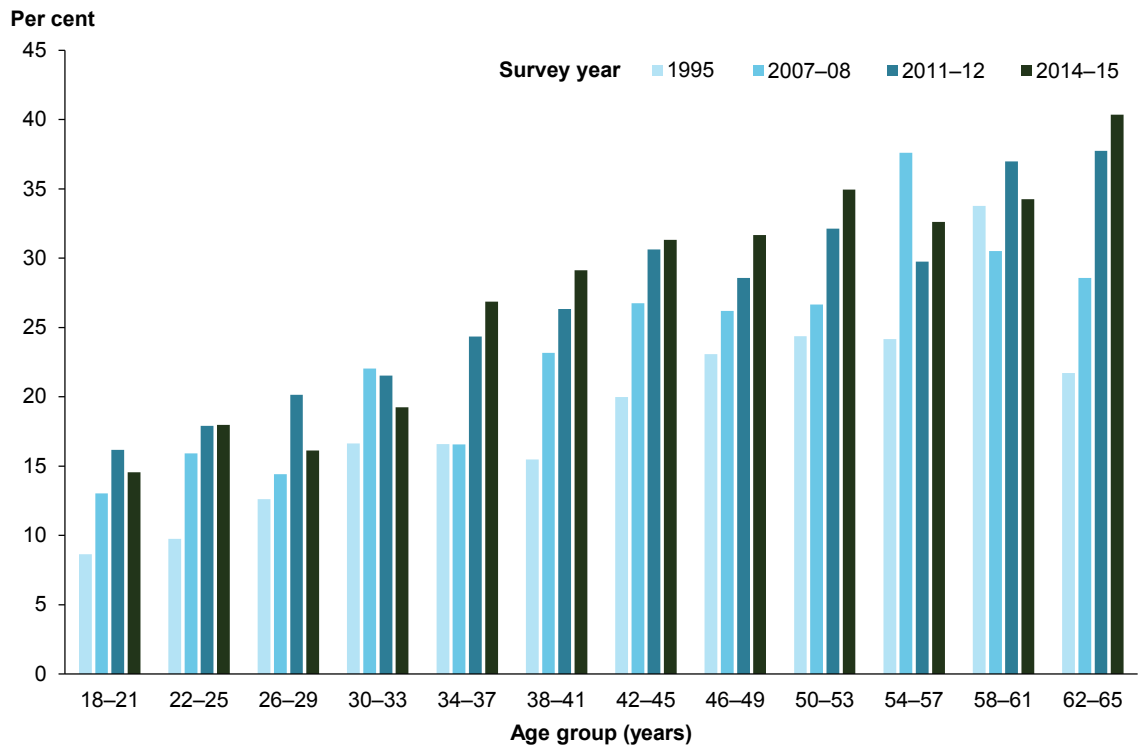
Figures 3.9 and 3.10 compare the prevalence of obesity at each survey by age, for each sex separately.

Both men and women in the birth cohort born most recently were significantly more likely to be obese at ages 38–41, 42–45, 46–49, and 54–57 than those born 20 years earlier (Table S4). Men in the birth cohort born most recently were also significantly more likely to be obese at ages 18–21, 26–29, and 58–61 than those born 20 years earlier, while women were also significantly more likely to be obese at ages 22–25, 34–37, 50–53, and 62–65 than those born 20 years earlier.

At ages 26–29 and 46–49, men in the birth cohort born most recently were significantly more likely to be obese than those born 8 years earlier, while at ages 34–37 and 62–65, women in the birth cohort born most recently were significantly more likely to be obese than those born 8 years earlier.

It should be noted that the prevalence estimate for obesity among men aged 18–21 in 1995 had a relative standard error of between 25% and 50%, and should be used with caution (see 'Appendix A'). For more details, see Table S4.





Notes

1. Percentages are of the total for whom height and weight were measured.
2. For adults aged 18 and over, a BMI of 30.00 kg/m² or more is considered obese (WHO 2000).

Sources: AIHW analysis of ABS 2013b, ABS 2010, ABS 2014 and ABS 2016; Table S4.

Figure 3.10: Proportion of obese women aged 18-65, by age group (years), 1995 to 2014-15

Severe obesity

Figure 3.11 shows how the prevalence of severe obesity among adults changed with age among each birth cohort.

The birth cohorts born from 1950–1953 through to 1974–1977 can be followed over 20 years. For each of these birth cohorts, the prevalence of severe obesity rose significantly as they aged 20 years. For example, for those born in 1974–1977, the prevalence of severe obesity rose almost 5-fold with age, from 2.2% at age 18–21 to 10.8% at age 38–41.

Among some birth cohorts, the prevalence of severe obesity appeared to fall between the 2 most recent surveys, but these decreases were not statistically significant.

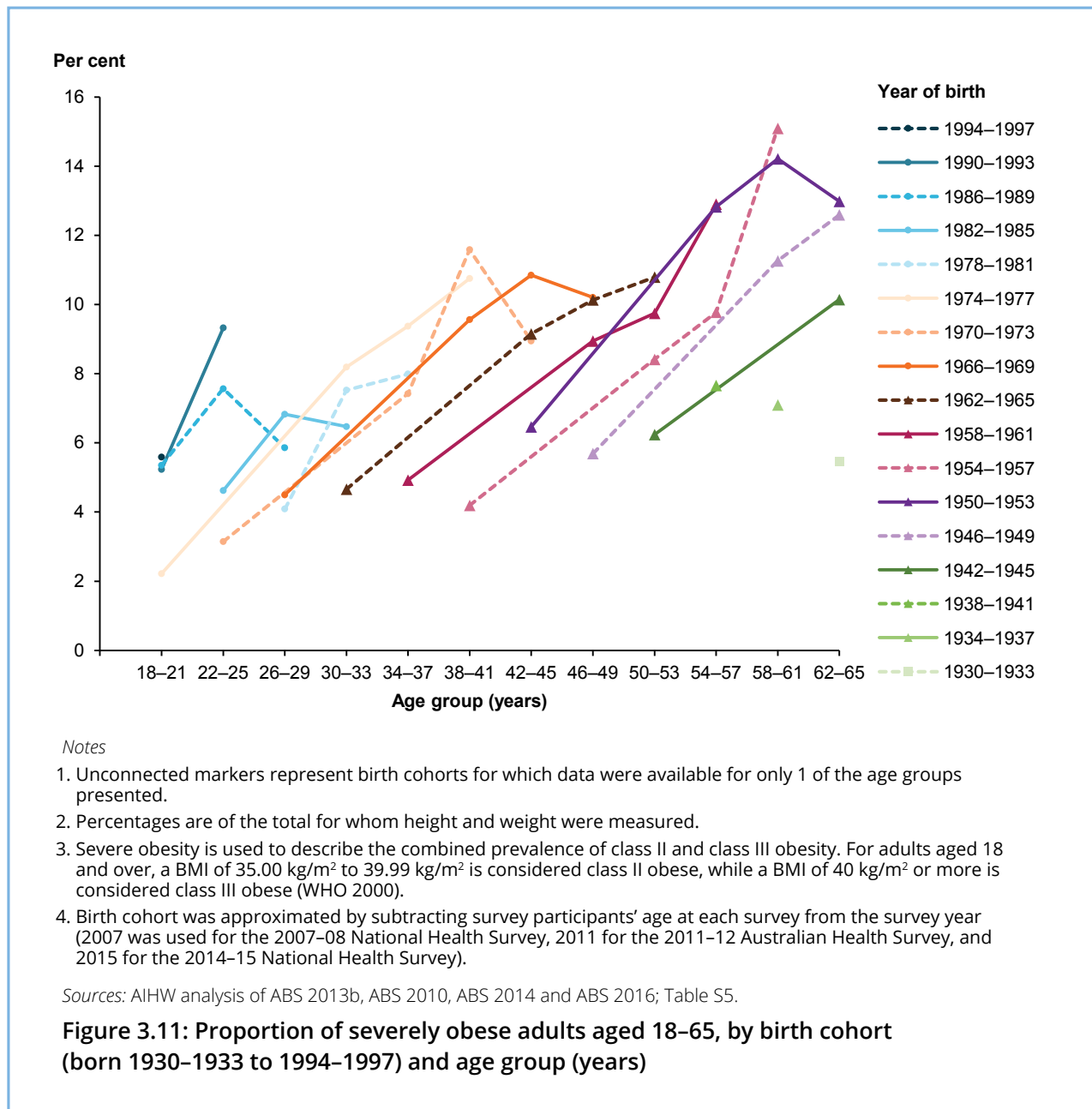


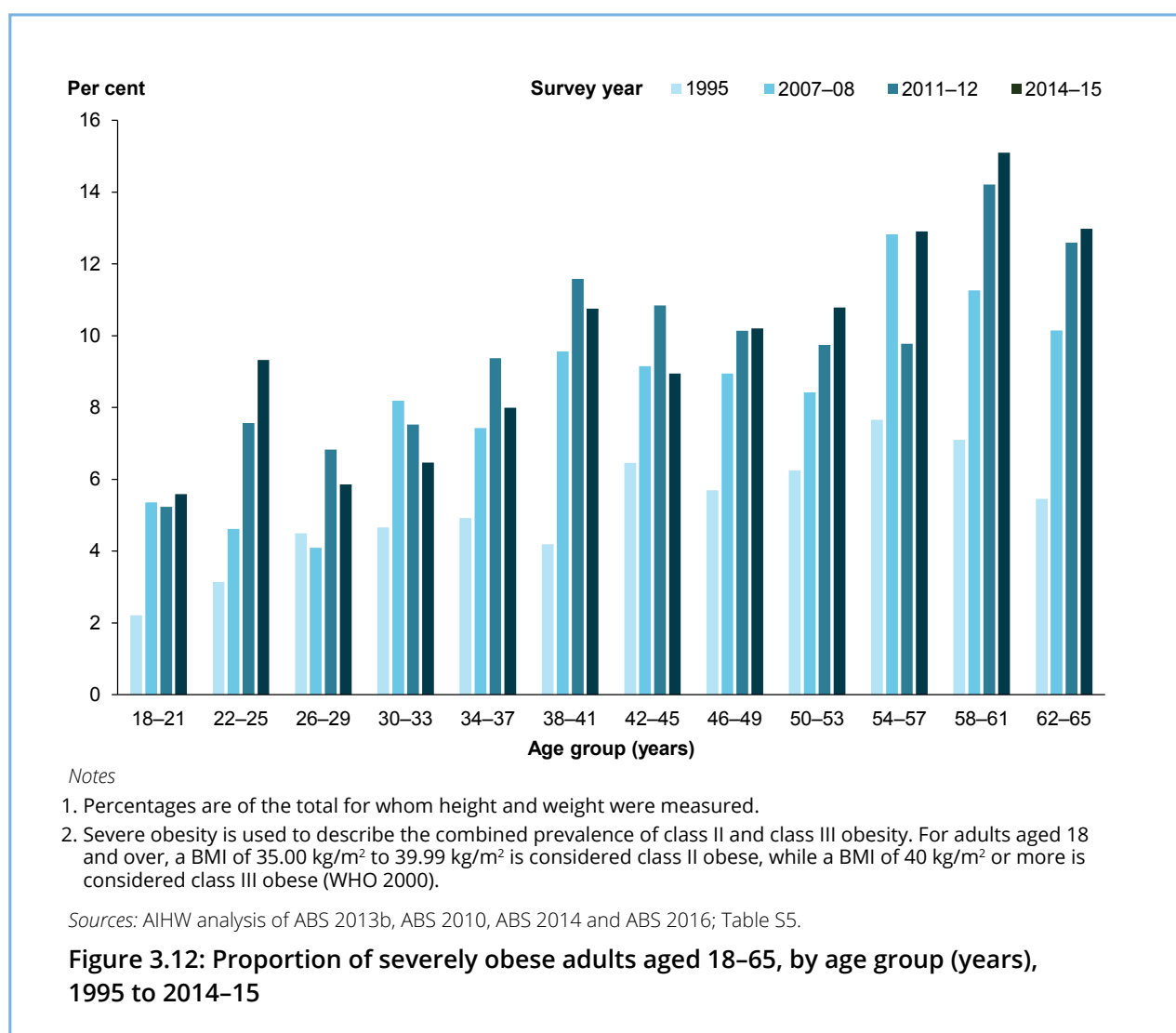
Figure 3.12 shows another way of looking at the data shown in Figure 3.11. It shows the prevalence of severe obesity among each age group at each of the 4 surveys.

At most adult ages (except for ages 26–29, 30–33, and 42–45), the prevalence of severe obesity was significantly higher in 2014–15 than in 1995 (Table S5).

Put another way, those in the birth cohort born most recently at each age (measured in 2014–15) were significantly more likely to be severely obese than those born 20 years earlier (measured in 1995). The largest relative difference was for age 22–25, where 9.3% of those born in 1990–1993 were severely obese, compared with 3.1% of those born in 1970–1973.

At age 22–25, the prevalence of severe obesity was significantly higher in 2014–15 than in 2007–08. At all adult ages, the difference between 2011–12 and 2014–15 was not statistically significant.

It should be noted that some prevalence estimates had a relative standard error of between 25% and 50%, and should be used with caution (see 'Appendix A'). For more details, see Table S5.



Analysis of severe obesity by sex is not included due to the small number of survey participants who were severely obese at some ages (and the associated high relative standard error of these prevalence estimates).

Abdominal obesity

Figure 3.13 shows how the prevalence of abdominal obesity among adults changed with age among each birth cohort.

The birth cohorts born from 1950–1953 through to 1974–1977 can be followed over 20 years. For each of these birth cohorts, the prevalence of abdominal obesity rose significantly as they aged 20 years. For example, for those born in 1974–1977, the prevalence of abdominal obesity rose about 5-fold with age, from 7.2% at age 18–21 to 36.9% at age 38–41.

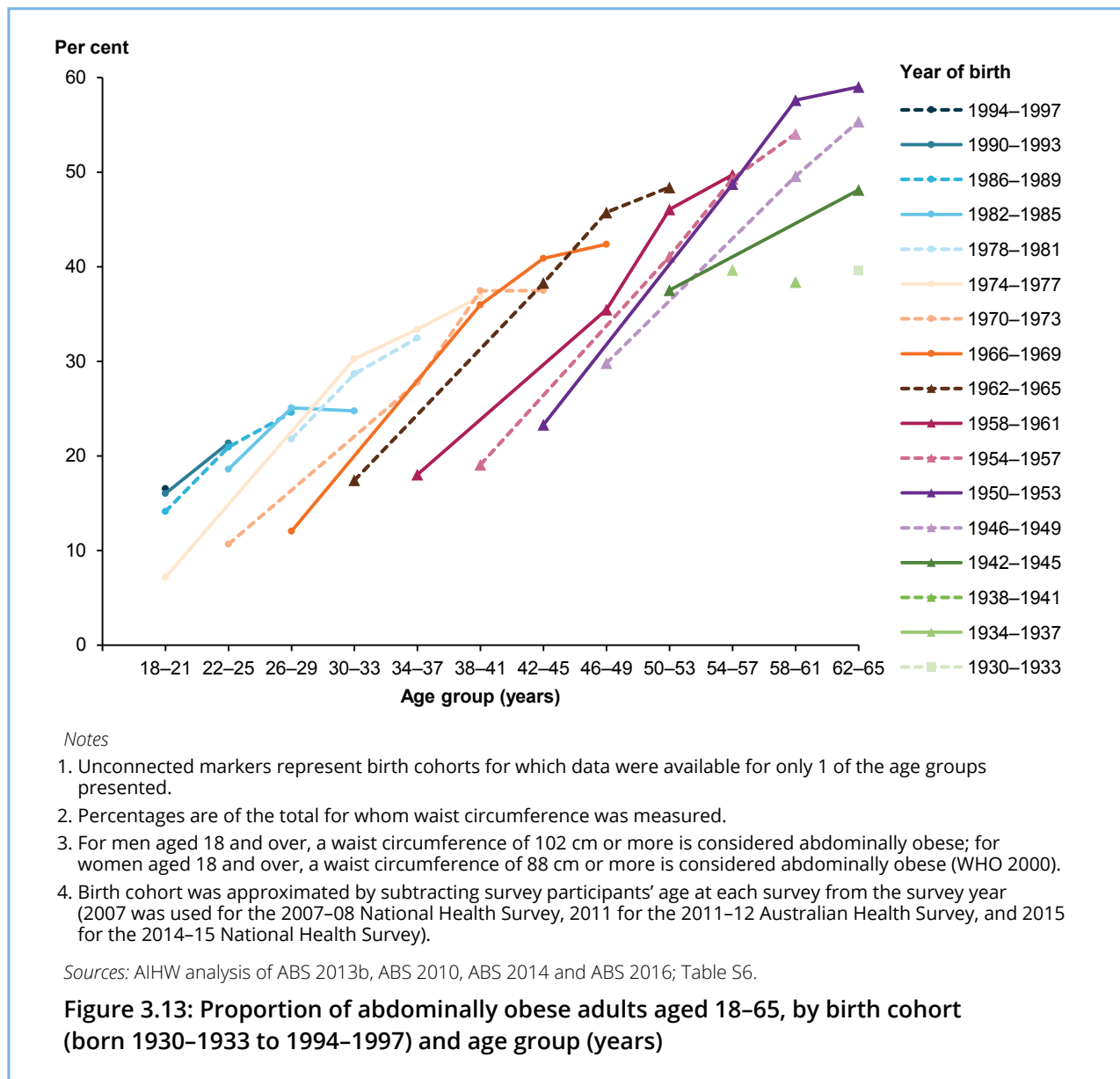
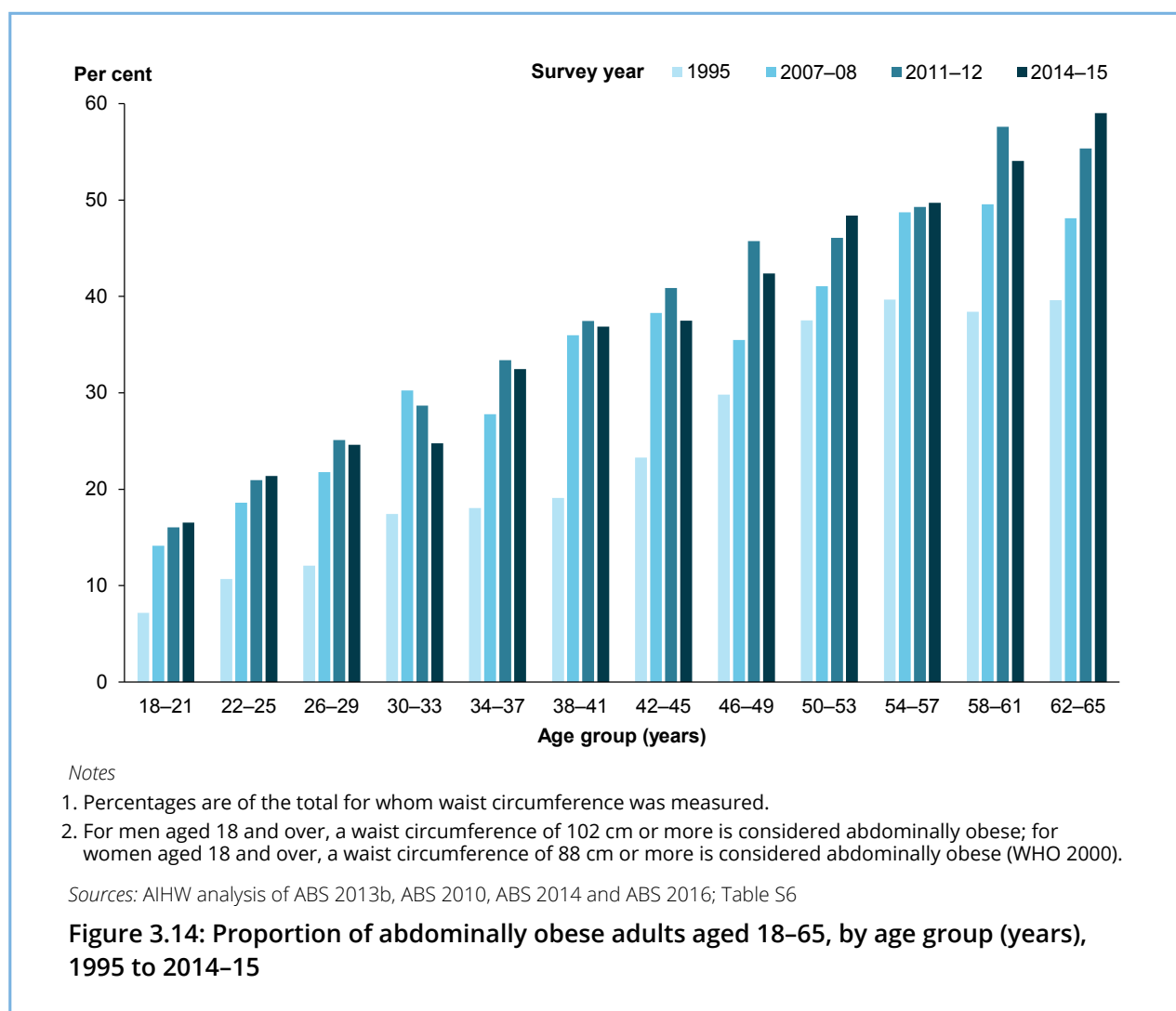


Figure 3.14 shows another way of looking at the data shown in Figure 3.13. It shows the prevalence of abdominal obesity among each age group at each of the 4 surveys.

At all adult ages, the prevalence of abdominal obesity was significantly higher in 2014–15 than in 1995. Put another way, those in the birth cohort born most recently at each age (measured in 2014–15) were significantly more likely to be abdominally obese than those born 20 years earlier (measured in 1995). The largest relative difference was at age 18–21, where 16.5% of those born in 1994–1997 were abdominally obese compared with 7.2% of those born in 1974–1977.

At ages 46–49, 50–53, and 62–65, the prevalence of abdominal obesity was significantly higher in 2014–15 than in 2007–08. At age 30–33, it was significantly lower in 2014–15 than in 2007–08. At all adult ages, the difference between 2014–15 and 2011–12 was not statistically significant.



There were some differences by sex. Women in the birth cohort born most recently were significantly more likely to be abdominally obese at every adult age than those born 20 years earlier. Men in the birth cohort born most recently were significantly more likely to be abdominally obese at ages 18–21, 22–25, 26–29, 38–41, 42–45, 58–61, and 62–65 than those born 20 years earlier (Table S6).

At age 62–65, both men and women in the birth cohort born most recently were significantly more likely to be abdominally obese than those born 8 years earlier. Men in the birth cohort born most recently were also significantly more likely to be abdominally obese at ages 18–21 and 46–49 than those born 8 years earlier. Women in the birth cohort born most recently were also significantly more likely to be abdominally obese at age 34–37 than those born 8 years earlier.

It should be noted that some sex-specific prevalence estimates had a relative standard error of between 25% and 50%, and should be used with caution (see 'Appendix A'). For more details, see 'Table S6'.



4 Discussion

This report looked at the prevalence of overweight and obesity by birth cohort, using cross-sectional survey data collected at different time points between 1995 and 2014–15 to construct birth cohorts. It compares the prevalence of overweight and obesity among these different birth cohorts at the same ages, and looks at changes as the birth cohorts age.

The key findings of the report, their potential causes and implications, and the limitations of the analysis are discussed in this section.

Children and adolescents aged 10–13 and 14–17 in 2014–15 were more likely to be overweight or obese than their counterparts 20 years earlier

At ages 10–13 and 14–17, the prevalence of overweight and obesity was significantly higher among children and adolescents in the most recent birth cohort compared with those born 20 years earlier. Differences in the prevalence of obesity were not statistically significant among children and adolescents in the birth cohort born most recently compared with those born 20 years earlier, except at age 2–5 where it was significantly higher for those in the birth cohort born most recently.

The finding for obesity is similar to that of a systematic review and meta-analysis of childhood overweight and obesity in Australia between 1985 and 2008, which reported an apparent plateau in the prevalence of childhood obesity, based on BMI, from the mid- to late 1990s (Olds et al. 2010).

The review also reported an apparent plateau in the prevalence of overweight and obesity combined. In contrast, in this report, the prevalence of overweight and obesity among children and adolescents aged 10–13 and 14–17 was significantly higher in the birth cohort born most recently compared with those born 20 years earlier. The difference between the review and this report might be due to differences in method—for example, this report includes data up until 2014–15, while the review included data up until 2008. There are also differences in the age groupings used.

When comparing the birth cohorts born most recently with those born 4 or 8 years earlier, the differences in the prevalence of overweight and obesity or of obesity alone were not statistically significant.

The differences between those born most recently and those born 4 or 8 years earlier are smaller than those between children and adolescents born most recently and those born 20 years earlier. This could mean the prevalence of overweight and obesity, or of obesity alone, is stabilising. It could also be a real difference that was not found to be statistically significant due to sample size and the shorter period of time between birth cohorts. For further discussion, see 'Limitations of this analysis' in this chapter.

Adults in 2014–15 were more likely to be obese than adults of the same age 20 years earlier

Adults in the birth cohort born most recently were significantly more likely to be obese at all but 1 of the age groups assessed than adults born 20 years earlier. At most adult ages (except at ages 30–33 and 50–53 through to 58–61), adults in the birth cohort born most recently at each age were also significantly more likely to be overweight or obese than those born 20 years earlier.

The obesity finding is similar to those of previous birth cohort studies in Australia, which have reported increased prevalence of obesity at any particular age among those born more recently when compared with those born earlier (AIHW: Bennett et al. 2004; Allman-Farinelli et al. 2008; Pilkington et al. 2014). Similar results have also been reported in New Zealand, with birth cohorts born more recently being more likely to be obese at any given age (New Zealand Ministry of Health 2015).

When comparing the birth cohorts born most recently with those born 4 or 8 years earlier, the differences in the prevalence of obesity were not statistically significant. The differences between adults born most recently and those born 4 or 8 years earlier are smaller than those between adults born most recently and those born 20 years earlier. This could mean the prevalence of obesity is stabilising. It could also be a real difference that was not found to be statistically significant due to sample size and the shorter period of time between birth cohorts. For further discussion, see 'Limitations of this analysis' in this chapter.

Adults born more recently were more likely to be severely obese at several ages than their counterparts 20 years earlier

At several ages, the prevalence of severe obesity was significantly higher among those in the birth cohort born most recently compared with those born 20 years earlier. For example, in 2014–15, 8.0% of adults aged 34–37 were severely obese compared with 4.9% of adults at the same age in 1995.

This is consistent with the shift in the overall population distribution of BMI towards higher values between 1995 and 2014–15 (AIHW 2017a).

The relative differences in abdominal obesity over time were greater than for obesity based on BMI

Among adults in 2014–15, the prevalence of abdominal obesity (based on waist circumference) was greater than the prevalence of obesity (based on BMI) at each age.

When comparing adults in the birth cohort born most recently and those born 20 years earlier, the relative differences in prevalence for abdominal obesity were generally greater than for obesity based on BMI.

The higher prevalence of abdominal obesity than obesity is consistent with data from the Australian Diabetes, Obesity and Lifestyle Study (a cohort study), which found a higher incidence of obesity over a 12-year period when obesity was defined by waist circumference than when it was defined by BMI (Tanamas et al. 2014).

What are the causes?

While this report describes changes in the prevalence of obesity at given ages between different birth cohorts, it does not identify the factors contributing to these changes.

Obesity occurs primarily because of an imbalance between energy intake and energy expenditure. Given this, an increase in energy intake and/or a decrease in energy expenditure is the most plausible explanation for increases in the prevalence of overweight and obesity and of obesity among more recently born birth cohorts compared with those born 20 years earlier. Diet and physical activity are, however, difficult to measure, and trend data in Australia are limited.

The authors of a previous birth cohort study proposed that the greater prevalence of obesity among more recently born birth cohorts was likely due to the birth cohorts born more recently having spent greater proportions of their lives in an obesogenic environment (Allman Farinelli et al. 2008).

An obesogenic environment is one that promotes obesity among individuals or populations, and includes aspects of the:

- physical environment—such as food availability in supermarkets, workplaces, and schools, and the availability of footpaths and recreational facilities
- economic environment—such as personal income, and the cost of food
- political environment—such as policies, regulations, and laws around food labelling and advertising
- sociocultural environment—such as media and social and cultural norms (Swinburn et al. 1999).

Examples of environmental factors that contribute to overweight and obesity include:

- a wide availability of cheap processed foods that provide excess kilojoules
- larger portion sizes
- replacement of physically active workplaces with more sedentary occupations
- longer working hours leaving less time for food preparation and physical activity (NHMRC 2013).

Several policy options included in the WHO's Global action plan for the prevention and control of noncommunicable diseases 2013–2020 address the obesogenic environment. These include:

- policies to reduce marketing of less healthy foods to children
- taxes and subsidies to encourage consumption of healthier foods and discourage consumption of less healthy foods
- promotion of provision of healthier foods in public institutions, such as schools and workplaces (WHO 2013).

In this report, there were few significant differences when comparing the prevalence of obesity among the birth cohort born most recently at each age with those born 4 or 8 years earlier. This could mean the prevalence of obesity is stabilising. It could also be a real difference that was not found to be statistically significant due to sample size and the shorter period of time between birth cohorts. For further discussion, see 'Limitations of this analysis' in this chapter.

If the absence of a significant difference does mean the prevalence of obesity is stabilising, this could be due to public health initiatives, which have targeted lifestyle factors such as diet and physical activity. See *A picture of overweight and obesity in Australia* (AIHW 2017a) for an overview of population health approaches targeting overweight and obesity.

What are the implications?

Children and adolescents who are overweight or obese are more likely to be overweight or obese as adults than children of a normal weight (Singh et al. 2008). The higher prevalence of overweight and obesity at younger ages is likely to track into an increased prevalence in adulthood among the birth cohorts born more recently.

Given obesity is a risk factor for several chronic conditions, the higher prevalence of obesity at younger ages among birth cohorts born more recently is likely to be followed by a rising prevalence of obesity-related chronic conditions at younger ages. This will in turn lead to higher health-care costs. A previous Australian study, for example, found higher hospital admission rates, days spent in hospital, and hospital costs with increasing BMI among adults aged 45–64 and 65–79 (Korda et al. 2015).

This report also found a significantly higher prevalence of severe obesity at several ages among those in the birth cohort born most recently than among those born 20 years earlier. This is likely to have similar, but more severe, consequences as those of a higher prevalence of obesity. As an example, in 1 Australian study, the health-care costs for a severely obese population were more than double those for the general population, with the difference appearing to be due to greater use of services among the severely obese population (Keating et al. 2012).

In this report, the prevalence of abdominal obesity (as indicated by waist circumference) was higher than that of obesity (as indicated by BMI). Given waist circumference is a better predictor of the risk of cardiovascular disease than BMI (National Vascular Disease Prevention Alliance 2012), prevalence estimates of obesity based on BMI alone might underestimate the population at higher risk of cardiovascular disease due to excess body fat.

This report did not include analysis by population characteristics—such as socioeconomic group, remoteness area, or ethnicity—and findings could differ for different population subgroups. For example, other analyses have shown increasing relative differences in BMI by educational attainment over time in Australia, with higher mean BMI among those with low education levels than among those with high education levels (Gearon et al. 2015). As a result, the implications for certain subgroups could also differ.

Finally, while the potential stabilisation in obesity among birth cohorts born more recently is encouraging, the prevalence of obesity remains high by historic standards, and it remains a major public health issue in Australia. Any stabilisation in the prevalence of childhood obesity could also be only temporary if efforts are not continued (Olds et al. 2010).

Limitations of this analysis

In this report, there will have been some misclassification of birth cohort, given year of birth was approximated from age at survey and an assigned survey year. For example, interviews for the 2007–08 National Health Survey were conducted from August 2007 to June 2008. As the interview date for individual participants was not available, the 'survey year' was assigned as 2007.

The BMI and waist circumference cut-off points used in this report might be less appropriate for certain population groups, including various ethnic groups (see 'Box 1.1'). As it was not possible to distinguish ethnicity in the data sources in this report, the same cut off points were used for all survey participants (ABS 2013a). Variation in the ethnicity of the people in the different survey samples could have contributed to changes in the prevalence of overweight and obesity.

The estimates in this report are based on survey samples. The estimates are therefore subject to sampling error and may differ from the figures that would have been produced if data were collected from the complete population. Any changes between surveys may be indicative of real changes or may be influenced by sampling error, non-sampling error or both sampling and non-sampling error. For example, those who had their height, weight and waist circumference measured may have differed from those who did not (known as response bias). It is possible that the nature and extent of any response bias may have differed between surveys. Any such differences could contribute to changes in the prevalence of overweight and obesity.

This report covers a relatively short time period (about 20 years). An extension of this analysis could include earlier data, but given the available data, this analysis would be restricted to residents of capital cities.

Finally, some differences that were not found to be statistically significant based on the samples from the surveys might be real differences in the total population. A smaller survey sample will generally be less likely to find an observed difference to be statistically significant than a larger survey sample. This is because the accuracy of survey estimates generally increases as the sample size increases. This is important to consider in this report, where survey data were analysed by 4-year birth cohorts. As a survey's sample is divided into smaller groupings, the likelihood of finding differences to be statistically significant is reduced. This is of particular relevance when comparing those born most recently with those born 4 or 8 years earlier, where any difference is likely to be smaller than that observed between those born most recently and those born 20 years earlier.

Conversely, it is possible that some differences that were found to be statistically significant based on the samples from the surveys might not be real differences in the total population, and be due to chance alone.

Appendix A: Detailed methods

Data sources

The analyses presented in this report are based on data collected in the following national cross-sectional surveys conducted by the ABS—the 1995 National Nutrition Survey, the 2007–08 National Health Survey, the 2011–12 Australian Health Survey, and the 2014–15 National Health Survey.

The 2007–08 National Health Survey, the 2011–12 Australian Health Survey, and the 2014–15 National Health Survey were based on nationally representative samples that included only residents of private dwellings, and excluded residents of non-private dwellings such as hospitals, nursing homes, hotels, motels, boarding schools, and prisons.

The 1995 National Nutrition Survey was based on a subsample of participants from the 1995 National Health Survey. The subsample was designed to provide national estimates by fine age groups and sex. The 1995 National Nutrition Survey also included only residents of private dwellings.

The sample size in each survey varied, with about:

- 13,800 people surveyed in the 1995 National Nutrition Survey
- 20,800 people surveyed in the 2007–08 National Health Survey
- 32,000 people surveyed in the 2011–12 Australian Health Survey
- 19,300 people surveyed in the 2014–15 National Health Survey.

The 1995 National Nutrition Survey, 2011–12 Australian Health Survey, and 2014–15 National Health Survey included physical measurements for people aged 2 and over, while the 2007–08 National Health Survey included these for people aged 5 and over.

Each survey included collection of measured height, weight, and waist circumference by trained interviewers. The 1995 National Nutrition Survey used scales that could weigh a maximum weight of 140 kg. The 2007–08 National Health Survey, 2011–12 Australian Health Survey, and 2014–15 National Health Survey used scales that could weigh a maximum weight of 150 kg.

The response rates for physical measures varied between surveys. The non-response rates for physical measurements for adults were higher for the 2014–15 National Health Survey (26.8%) than for the 2011–12 National Health Survey (16.5%). In response, the ABS imputed BMI for those people for whom BMI was not measured in the 2014–15 National Health Survey. In this method, participants with a missing response were given the response of similar participants—the similarity of participants was based on age group, sex, part of state, self-perceived body mass, level of exercise, and whether or not a participant had high cholesterol as a long-term health condition (ABS 2015). There was no imputation of BMI in the 1995 National Nutrition Survey, the 2007–08 National Health Survey, and the 2011–12 Australian Health Survey.

For each survey, the ABS allocated a person weight to each participant. Estimates based on the person weights can be used to infer results for the in-scope population.

Methods

Birth cohort analysis

This report did not track the same individuals over time. Rather, birth cohorts were constructed using cross-sectional survey data representing the Australian population in 1995, 2007–08, 2011–12, and 2014–15. This approach treats, for example, survey participants aged 18–21 in 1995 and survey participants aged 38–41 in 2014–15 as representative of the same group of people, as they age 20 years between the surveys.

Year of birth was approximated by subtracting age at survey from survey year. For 3 of the surveys, interviews were conducted in 2 calendar years (for example, interviews for the 2007–08 National Health Survey were conducted from August 2007 to June 2008). Details of which year an individual was interviewed in were not available in the data sets. For these surveys, this analysis assigned survey year as 2007 for the 2007–08 National Health Survey, 2011 for the 2011–12 Australian Health Survey, and 2015 for the 2014–15 National Health Survey (the use of 2015 for the 2014–15 survey maintained the gap of about 4 years between more recent surveys). Records were then grouped into cohorts based on approximated year of birth, using 4-year spans. Because of the spacing of the surveys, the use of 4-year spans enabled comparison of 4 different birth cohorts at the same age, with no overlap of birth cohorts.

For each birth cohort, at each survey year, several measures were calculated for total persons and by sex. These were the percentage of birth cohort who were:

- overweight or obese, based on BMI
- obese, based on BMI
- severely obese, based on BMI (for adults only)
- abdominally obese, based on waist circumference (for adults only).

For children and adolescents, age- and sex-specific half-year BMI cut-off points were used (Cole et al. 2000). For adults:

- overweight and obesity was classified as a BMI of 25.00 kg/m² or more
- obesity was classified as a BMI of 30.00 kg/m² or more
- severe obesity was used to describe the combined prevalence of class II and class III obesity—class II obesity was classified as a BMI of 35.00 kg/m² to 39.99 kg/m², while class III obesity was classified as a BMI of 40.00 kg/m² or more
- abdominal obesity was classified as a waist circumference of 102 cm or more for men, and of 88 cm or more for women.

In this report, results are presented for ages 2–5 through to 62–65. Data for those aged 2–5 in 2007–08 are not included, as the 2007–08 National Health Survey included physical measurements only for people aged 5 and over.

The statistical significance of the difference in prevalence estimates at each age between people in the birth cohort born most recently and those born 4, 8, and 20 years earlier was assessed using z scores. For further details, see 'Significance testing' in this appendix.

Crude prevalence estimates

Crude prevalence estimates are presented as percentages in this report. Crude prevalence, as a percentage, is defined as the number of people with a particular characteristic, divided by the number of people in the population of interest, multiplied by 100.

In calculating crude prevalence estimates, those people for which the information of interest (for example, BMI or waist circumference) was not available were excluded from the denominator.

All crude prevalence estimates in this report are weighted estimates that use person weights allocated to each survey participant by the ABS.

Standard error, relative standard error, and confidence intervals

For all survey data, the jack-knife weight replication method was used to derive the standard errors for each number estimate, using replicate weights provided by the ABS.

Once the standard error for the number estimates was produced, the standard error for the proportion was derived as follows:

$$SE\left(\frac{x}{y}\right) = RSE\left(\frac{x}{y}\right) \times \left(\frac{x}{y}\right)$$

where $RSE\left(\frac{x}{y}\right)$ is calculated as shown below.

The relative standard error of an estimate is a measure of the percentage errors likely to have occurred due to sampling. The relative standard error of an estimate is calculated as follows:

$$RSE\%(x) = \frac{SE}{x} \times 100$$

Estimates with a relative standard error greater than 50% are considered unreliable. No estimates in this report have a relative standard error greater than 50%. Caution should be used when a relative standard error is between 25% and 50%. These cases have been highlighted in the text as relevant, and marked with a # in the supplementary data for this report.

The relative standard error for the proportion was derived from the standard error of both the estimate for the numerator (x) and the denominator (y) as follows:

$$RSE\left(\frac{x}{y}\right) = \sqrt{RSE(x)^2 - RSE(y)^2}$$

where x is a subset of y and y is a survey estimate of the number of people in a group.

The 95% confidence interval around the proportion estimates (P) was derived as follows:

$$LCL = P - (1.96 \times SE\left(\frac{x}{y}\right))$$
$$UCL = P + (1.96 \times SE\left(\frac{x}{y}\right))$$

where:

LCL = lower confidence limit

UCL = upper confidence limit.

Significance testing

Variation or difference in observed proportions might reflect only a random variation or difference. To assess whether differences between estimates are statistically significant—that is, that they are unlikely to be due to chance alone—a z score for the difference in observed proportions was calculated using the following formula:

$$z = \frac{(\textit{proportion 1}) - (\textit{proportion 2})}{\sqrt{(\textit{SE of proportion 1})^2 + (\textit{SE of proportion 2})^2}}$$

If z was greater than -1.96 or less than 1.96, the difference was not considered statistically significant at the 95% confidence level.

If z was equal to or less than -1.96 or equal to or greater than 1.96, the difference was considered statistically significant at the 95% confidence level.

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Related publications

The following recent AIHW publications also relate to overweight and obesity:

- AIHW 2017. A picture of overweight and obesity in Australia 2017. Cat. no. PHE 216. Canberra: AIHW.
- AIHW 2017. Impact of overweight and obesity as a risk factor for chronic conditions. Australian Burden of Disease Study series no. 11. Cat. no. BOD 12. Canberra: AIHW.
- AIHW 2017. Weight loss surgery in Australia 2014–15: Australian hospital statistics. Cat. no. HSE 186. Canberra: AIHW.



Adults in 2014–15 were significantly more likely to be obese than adults of the same age 20 years earlier at almost any given age. At age 18–21, 15.2% of those born in 1994–1997 were obese, almost double the proportion of those born in 1974–1977 at the same age (8.0%). Children and adolescents in 2014–15 were also significantly more likely to be overweight or obese at ages 10–13 and 14–17 than those of the same age 20 years earlier.



Stronger evidence,
better decisions,
improved health and welfare

