

A guide to the graphics in *The Australian Paradox 2011*

In 2011, we published an article *The Australian Paradox: A Substantial Decline in Sugars Intake over the Same Timeframe that Overweight and Obesity Have Increased* (1). At that time, we took a lot for granted when we elected to include *all the data* that we had collected in our paper. We wrote the paper for dietitians and nutrition scientists, and in hindsight, we realise that our figure legends (graph descriptions) were too concise and did not include enough explanation of what they showed/did not show and how we had interpreted them. Because other scientists and members of the public have expressed interest in our paper, we have written a new expanded version of each legend, as shown below.

Figure 1.

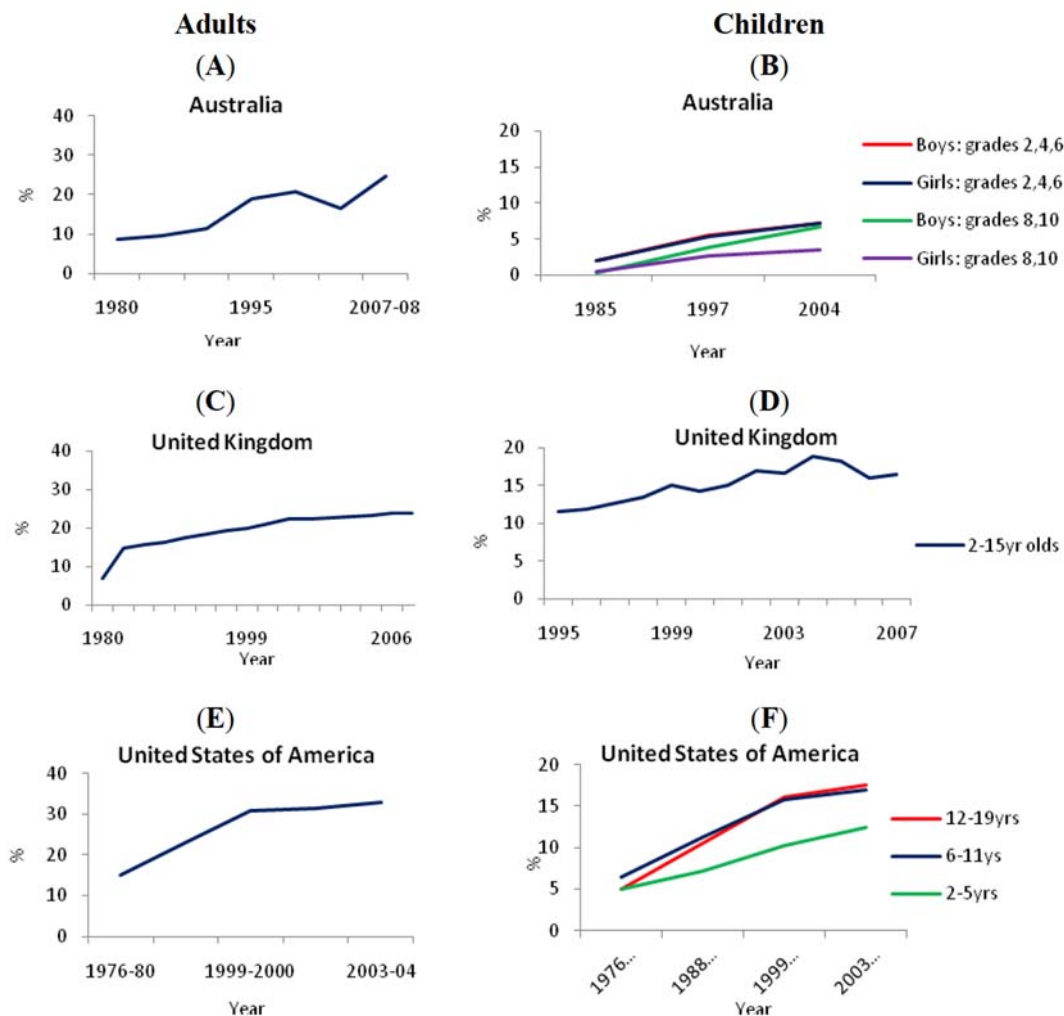


Figure 1 (original legend). Prevalence of obesity (%) in Australian adults (A), Australian children (B), adults in the United Kingdom (C), children in the United Kingdom (D) and American adults (E) and children (F) [18,23,24].

Additional text: The trends speak for themselves. Obesity is on the increase in Australia, the UK and USA, but note that there are fluctuations from year to year which may reflect methodological differences rather than true variation eg different surveys and sampling of the population. Note for graph (B): data for boys in grades 2, 4 and 6 are almost identical to girls in these grades).

Figure 2.

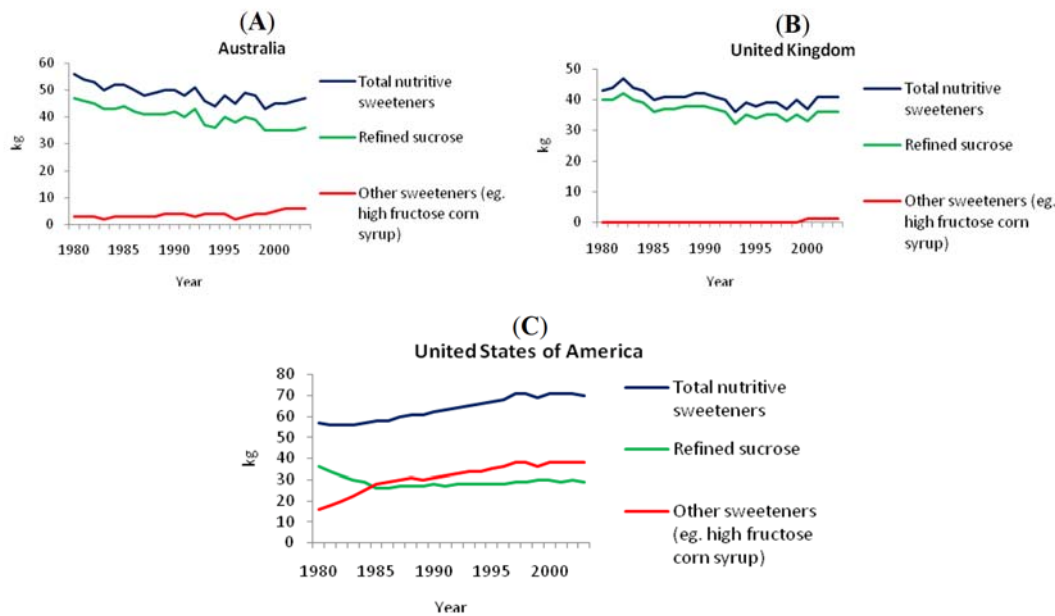


Figure 2 (original legend). Intake of added sugars (kg/capita/year) in (A) Australia, (B) the United Kingdom and (C) the United States of America [25].

Additional text: Trends in availability or ‘apparent consumption’ of total nutritive sweeteners (ie refined/added sugars) in Australia (A), the United Kingdom (B) and United States (C) expressed as kg per capita per year downloaded from FAOStat in 2009 and covering the years 1980-2003. The terms ‘refined sugars’, ‘added sugars’ and ‘nutritive sweeteners’ include all forms of energy-containing sweeteners (such as sucrose, glucose, fructose, lactose, maltose) that are added or incorporated into foods, *including those in processed and imported foods*.

The downward trend (-16%) in Australia contrasts with the upward trend in the USA (+23%) over the same timeframe. Thus on average, over a 23-year period, Australians removed 8.8 kg/year of refined/added sugars from their diet, equivalent to 24 g/day or 6 teaspoons.

Food availability figures such as these are acknowledged by dietitians and nutrition scientists as an overestimate of actual consumption but the changes over time are a reasonable reflection of *trends* in actual consumption. FAO derive their data from multiple sources. In Australia, from 1980 to 1998/9, the Australian Bureau of Statistics would be one source of data, but they ceased to publish *all* apparent consumption of food data after 2000 (not just refined sugars).

Food Balance Sheets are compiled every year by FAO, mainly with country-level data on the production and trade of food commodities. The FAO Methods and Standards use these data and the available information on waste coefficients, stock changes and types of utilization (feed, food, processing and other utilization), to prepare a supply/utilization account for each commodity in units of weight. The food component of the commodity account, which is derived as a balancing item, refers to the total amount of the commodity available for human consumption during the year, including processed products derived from the food commodity, expressed in primary commodity equivalent.

Figure 3.

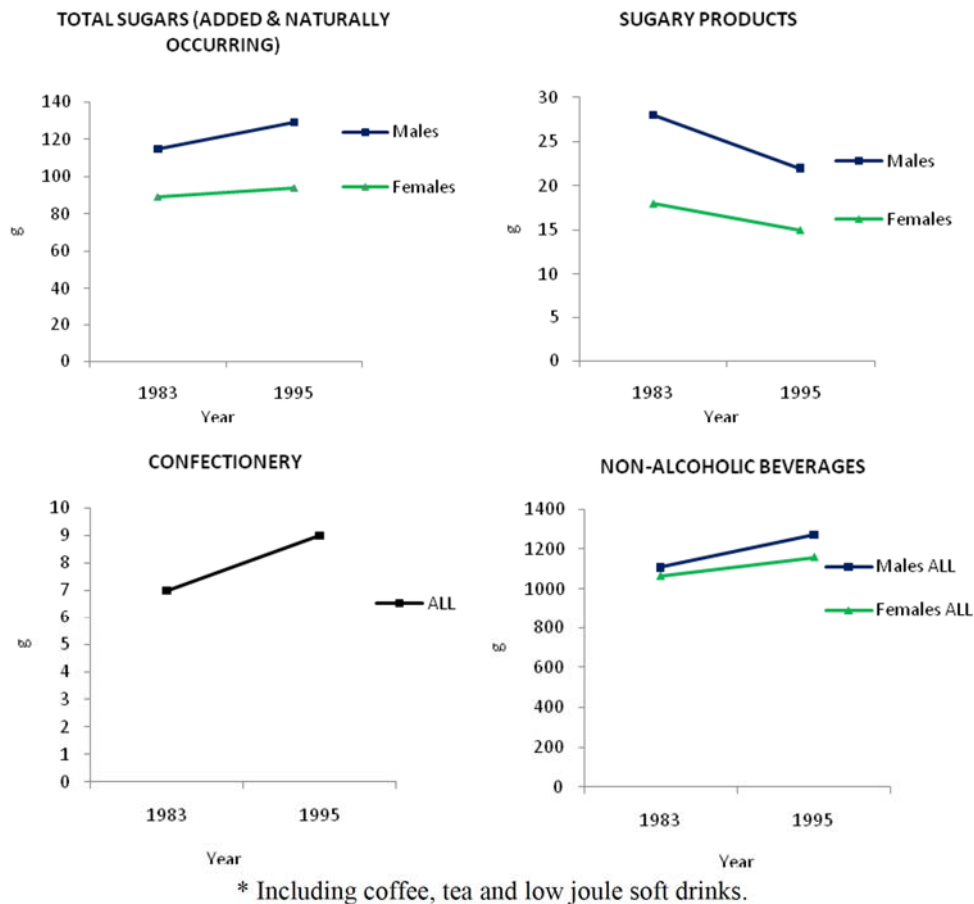


Figure 3 (original legend). 24 h mean intake (g) of total sugars, sugary products, confectionery and non-alcoholic beverages * by Australian adults (25–64 years) in 1983 and 1995 [19].

Additional text. All data are derived from the official national dietary surveys of Australian adults in 1983 and 1995.

(A, upper left) Average intake per person per day of total sugars including both *naturally-occurring* sugars in fruit, vegetables, juices, milk, yoghurt and other dairy products, *as well as* refined/added sugars (eg table sugar, or sucrose). Although there were small increases in total sugars from 1983 to 1995, there were sharper declines in *sugary products and dishes* that contribute refined/added sugars to the diet (see **Figure 3B**). *Sugary products and dishes* are defined below.

(B, upper right) Average intake per day of *sugary products and dishes*, including sugar, honey, syrups, jams, marmalades, chocolate spreads, as well as dishes and products other than confectionery where sugar is the major component eg meringue and jelly. It excludes chocolate confectionery (candy) and 'lollies'. Both males and females report declines in intakes of these foods, implying reductions in refined/added sugars intake from these sources. The percentage of the population who reported consuming a sugary product on the day of the survey, also decreased for men from 81% to 73% and for women from 72% to 62% between 1983 and 1995. Changes in the 'apparent consumption' data for sugars between 1983 and 1995 show a decrease of ~4 g per head per day (1 teaspoon) in the sugar supply (Figure 2A). This result is consistent with that found in reported intake data relating to sugar products and dishes even though apparent consumption data for sugars, *which includes sugars in manufactured foods* (2), may not be directly comparable with intake data for sugar products and dishes.

(C, lower left) Average intake per person per day of confectionery (eg chocolate, lollies and muesli bars). There is a rise in this food category but overall intake is still small (<10 g/day, equivalent to 2 squares of chocolate per day containing ~1 teaspoon of refined/added sugar in total).

(D, lower right) Average intake in grams per person per day of non-alcoholic beverages. Non-alcoholic beverages includes cups of coffee and tea, sugar-sweetened beverages and *'diet' or low joule beverages* but excludes plain drinking water. The upward trend in consumption of beverages may reflect the rising intake of coffee, or sugar-sweetened or diet beverages (as shown in **Figure 5**). From these data, we do not know how much sugar was added to coffee and tea, or the proportion of total beverage intake that was low joule or 'diet'. Overall the percentage of total food and beverage intake contributed by beverages (both alcoholic and non-alcoholic) to adult diets remained the same in 1983 and 1995 at 51% (2).

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Figure 4.

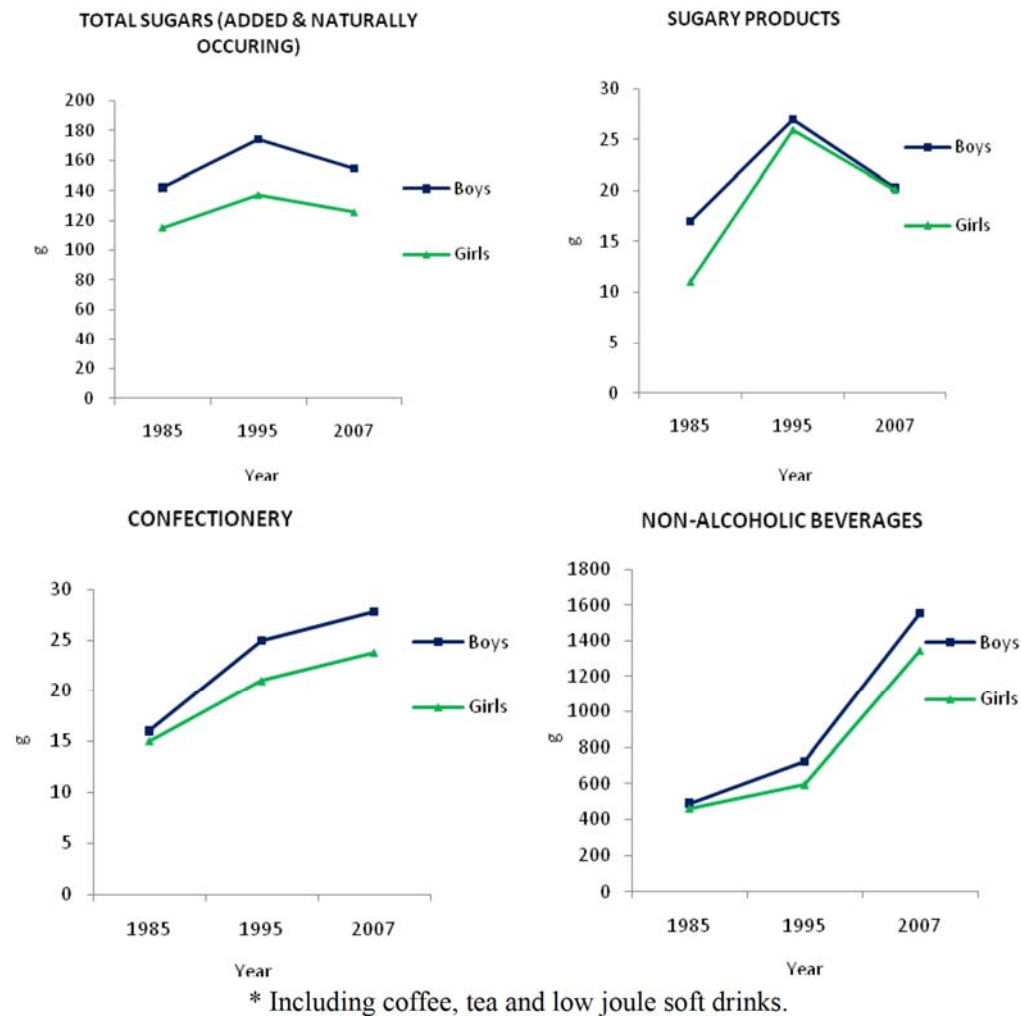


Figure 4 (original legend). 24 h mean intake (g) of total sugars, sugary products, confectionery and non-alcoholic beverages * by Australian children in 1985, 1995 and 2007 [5,19]. Note: the age categories used for comparison were 10–15 year old children in years 1985 and 1995, the 2007 figure is an average between intakes of 9–13 year and 14–16 year categories.

Additional text. All data are derived from the national dietary surveys of Australian children in 1985, 1995 and 2007.

(A, upper left) Average reported intake per child per day of total sugars including both naturally occurring sugars in fruit, vegetables, milk, yogurt and other dairy products and foods containing refined/added sugars.

(B, upper right) Average reported intake per day of sugary products and dishes (including sugar, honey, syrups, jams, marmalades, chocolate spreads, as well as dishes and products other than confectionery where sugar is the major component eg meringue and jelly). Both boys and girls show a rise and fall in intakes of these foods, implying a rise and fall in refined/added sugars intake from these sources. The reduction in intake from 1995 to 2007 coincided with a further increase in the prevalence of child overweight and obesity.

(C, lower left) Average reported intake per child per day of confectionery (eg chocolate, lollies). There is a consistent rise in the intake of confectionery (~10 g/day, or 2 squares of chocolate). Note that these figures indicate the weight of product, not the amount of added/refined sugars.

(D, upper right) Average reported intake in grams per child per day of non-alcoholic beverages, including absolute weight of coffee, tea, sugar-sweetened *and 'diet' or low joule beverages*. Note the weight of beverage in grams is approximately the same as the volume in mL (100 g = ~100 mL). From these data, we do not know how much sugar was added to coffee and tea, or the proportion of total beverage intake that was low joule or 'diet'. The upward trend in beverage consumption likely reflects the rising intake of diet beverages (as shown in Figure 5A). Overall, the percentage of total food and beverage intake (excluding plain drinking water) contributed by beverages (milk and non-alcoholic beverages) to children's diets increased from 53% to 54% for boys but remained at 53% for girls (2).

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Figure 5.

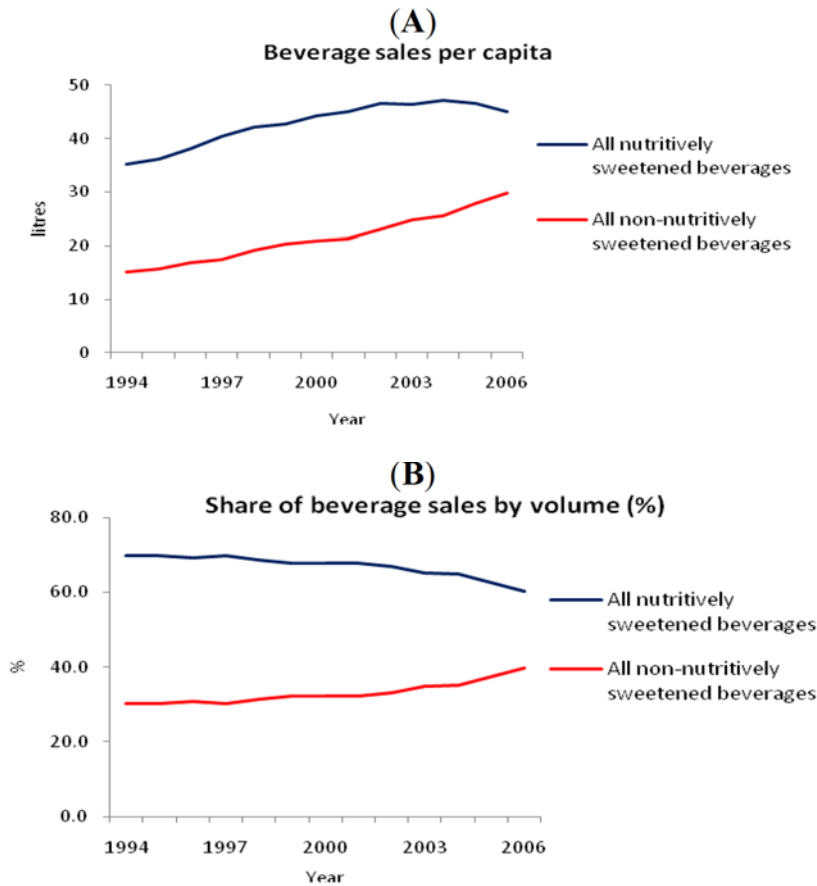


Figure 5 (original legend). Time trends in sales of nutritively sweetened beverages and non-nutritively sweetened beverages in grocery stores, expressed as (A) per capita volume sold in liters and as (B) a percentage of total volume sold [15,28–30].

Additional text. The graphics illustrate trends in Australian sales *by volume* of sugar-sweetened and low joule or ‘diet’ beverages according to grocery sales data. The data were taken from Levy and Tapsell (3) who relied on sales data provided by the Australian Beverage Council Ltd, representing major companies such as Coca-Cola Amatil Australia, PepsiCo Australia, Cadbury Schweppes Australia and Unilever Australasia. Their information was derived from AC Nielsen *Scan Track* and *Home Scan* showed annual grocery volume sales of non-alcoholic, water-based beverages starting from mid-1994 to mid-2006. These studies drew on information from 10,000 households, demographically and geographically representative of the Australian population. With a hand-held scanner, participants recorded all household grocery purchases from all retail outlets, including supermarkets, pharmacies and convenience stores over a one-year period.

(A) The upward time trends in sales *by volume* (litres) of both sugar-sweetened and diet beverages between 1994 and 2006 is obvious. *However, this should not be interpreted as an increase in intake of added sugars* (see **Figure 6** below). Many new formulations of sugar-sweetened beverages entered the market over this time frame, with lower sugar concentration (3-8 g/100mL vs 10-12 g/100 mL). For example, flavoured mineral waters contain 3 g per 100 mL of sugars, iced teas 4-5 g per 100 mL, sports drinks 6 g per 100 mL, whereas conventional soft drinks contain 10-12 g per 100 mL. Because there were no data on the changing proportions of sales in each variety, we could not assume that intake of refined/added sugars intake was increasing along with sales.

(B) The downward trend in market share of sugar-sweetened beverages is a sign that Australian preferences are changing. People were increasingly likely to choose a diet soft drink, or a

reduced-sugar alternative. Indeed, at the time Australia had one of the highest proportionate sales of diet soft drinks of any country in the world (4 in 10 beverages consumed are 'diet' beverages).

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Figure 6.

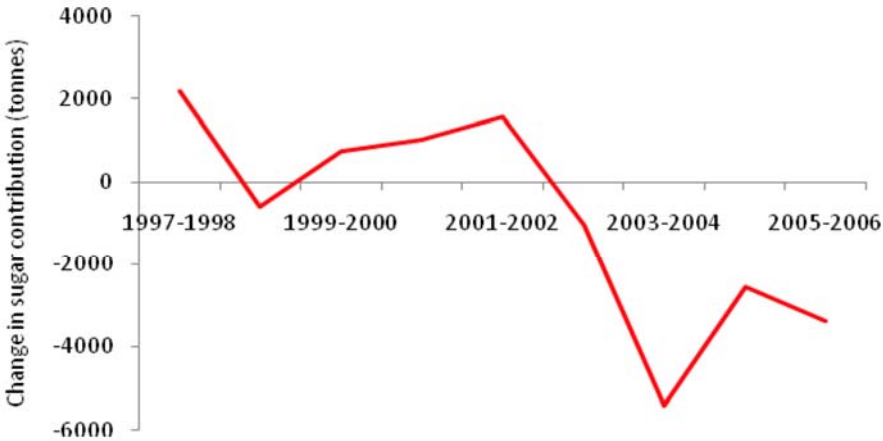


Figure 6 (original legend). Annual change in contribution of nutritively-sweetened carbonated soft drinks to total added sugar in the Australian food supply [30].

Additional text. This is an important graphic because it shows declines in the amount of sugar (tonnes) being incorporated into sugar-sweetened carbonated soft drinks during the period 1997/98 to 2005/06. The data are derived from Tapsell and Levy (3) who relied on sales data provided by the Australian Beverage Council Ltd. The downward trend over time is equivalent to 600 g per person over 4 years or 150 g/person/year. It is consistent with the decline in apparent consumption/sugar availability reported by FAOStat for the years 1998 (48.2 kg/capita/year) to 2006 (46.4 kg/capita/year) (**Figure 2A**). Over a decade, a cumulative decrease of 150 g/person/year amounts to removal of 1.5 kg refined sugar/person/year. We interpreted this as a sign that Australians were responding to health messages about sugars and were likely to be limiting other sources of refined/added sugars.

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Figure 7.

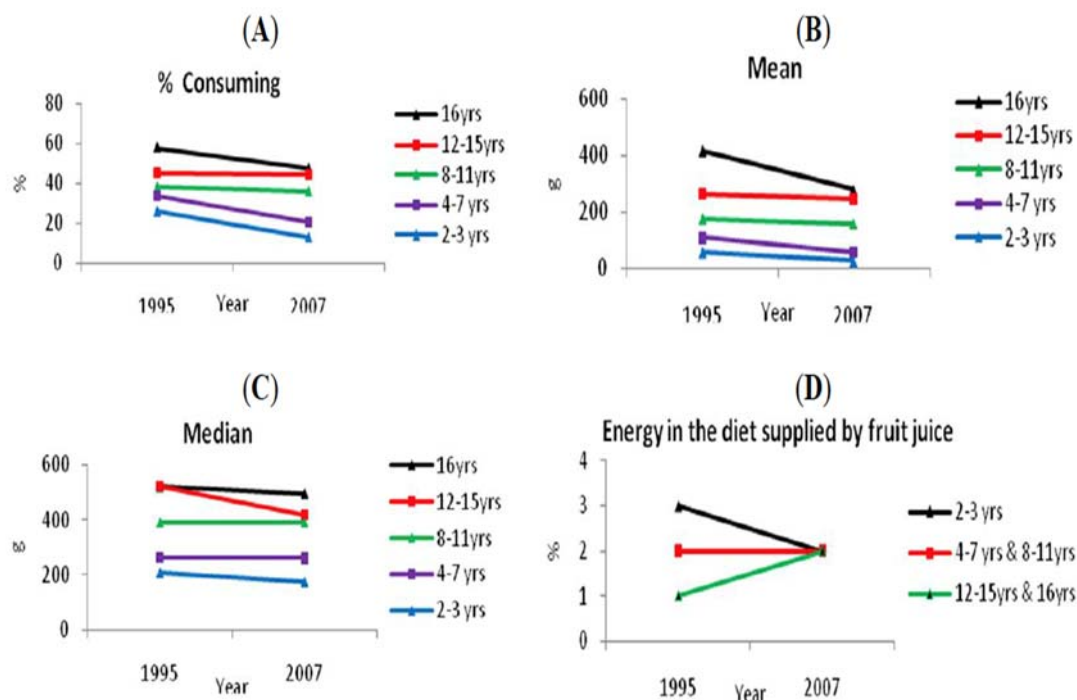


Figure 7. (A) Percent consuming, (B) mean intakes and (C) median intakes of soft drinks, flavored waters and electrolyte drinks by children in 1995 and 2007, and (D) percentage of energy supplied by fruit juice in the diets of children [5,26].

Additional text:

Figure 7A. In Australian national dietary surveys, the percentage of children who reported consuming sugar-sweetened and/or ‘diet’ beverages (hereafter referred to as soft drinks) declined between 1995 to 2007 [5,26]. The steepest decline was among young children 2-7 years of age, with no change among 8-15 year olds. Importantly, we cannot calculate the amount of refined or added sugar consumed because we do not know the proportions of diet beverages or the sugar concentration of the sugar-sweetened beverages. However, by 2007 parents appear to be more sugar-conscious and much less likely to offer soft drinks to children under 8.

Figure 7B. These figures apply *only* to those who consumed soft drinks on the day of survey and provide an impression of usual serving size. The highest consumers in both surveys were 16 year olds. The largest falls in intakes were in young children aged 2 to 7 years. Not surprisingly, the highest consumers were teenagers >15 years of age, but they consumed 25% less soft drink in 2007 than in 1995. Based on these data, we cannot determine the amount of refined/added sugar consumed because we do not know the proportions of diet beverages, or the sugar concentration of the sugar-sweetened beverages. By 2007, it is clear that parents were less likely to offer soft drinks to children under 8.

Figure 7C. These figures apply only to those who consumed soft drinks on the day of survey. The median amount consumed is the 50th percentile of intake. Again, 16 year olds had the highest intake and the 50th percentile remained the same in both surveys. Only 12-15 year olds showed a noticeable decline in median amount consumed. The differences between Figure 7B and 7C imply that *some* teenagers are consuming very large amounts, but we do not know the proportion that is ‘diet’ soft drink. Again, we cannot calculate how much refined/added sugars is being consumed, although the downward direction of the trend from 1995 to 2007 is consistent with other datasets.

Figure 7D. This graphic shows that the percentage of energy supplied by fruit juice is small (only 1-2% in 2007). From a very low base in 1995, the time trend is *up* for teenagers over 12 years and *down* for 2-3 year olds. Taken together, the data could be interpreted to suggest that fruit juice has replaced

soft drink in the diet of some teenagers, and another indication that health messages about soft drink have had some impact. If true, then the intake of naturally-occurring sugars has increased in teenagers at the expense of refined sugars.

Final comment

Three independent sources of information about refined/added sugars in foods (FAOStat, national dietary surveys, Neilson grocery sales data) provide support for our hypothesis. Australians have been sugar-conscious since 1980 and actively making efforts to reduce their intake (except when it comes to chocolate!). All sources of data like this have their strengths and weaknesses. We interpreted the 16% decline in availability of sugars and sweeteners according to FAOStat data as *the most objective sign* and consistent with a downward trend in other datasets.

Although national nutrition survey data may underestimate consumption of unhealthy food items, trends over time are consistent with ‘apparent consumption’ data collected by the Food and Agriculture Organisation. The decline in consumption of sugary products and dishes (eg table sugar, honey, jam etc) by adults in the national dietary survey of 1995 was consistent with a downward trend. The decline in percentage of children who consumed a sugar-sweetened beverage on the day of the 2007 survey, and the reduction in beverage volume consumed by some age groups, were further support. Finally, the rise in grocery sales of low joule (‘diet’) soft drinks, and decline in the amount of sugar incorporated into sugar-sweetened soft drinks in 2002-2006 were also suggestive of a significant change in Australia’s soft drink preferences.

Taken together, this interpretation of the data provided the basis for the formulation of our hypothesis: declining intake of refined sugars in the face of a sharp rise in the prevalence of obesity in adults and children - an *Australian Paradox*.

References

1. Barclay A, Brand-Miller J. The Australian Paradox: A Substantial Decline in Sugars Intake over the Same Timeframe that Overweight and Obesity Have Increased. *Nutrients*. 2011;3:491-504.
2. Cook P, Rutishauser IHE, Allsopp R. The Bridging Study—Comparing Results from the 1983, 1985 and 1995 Australian National Nutrition Surveys. Canberra, Australia: Commonwealth Department of Health and Aged Care, 2001.
3. Levy G, Tapsell L. Shifts in purchasing patterns of non-alcoholic, water-based beverages in Australia, 1997–2006. *Nutr Diet*. 2007;64:268–79.