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Worldwide trends in dietary sugars intake

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Abstract

Estimating trends in dietary intake data is integral to informing national nutrition policy and monitoring progress towards dietary guidelines. Dietary intake of sugars is a controversial public health issue and guidance in relation to recommended intakes is particularly inconsistent. Published data relating to trends in sugars intake are relatively sparse. The purpose of the present review was to collate and review data from national nutrition surveys to examine changes and trends in dietary sugars intake. Only thirteen countries (all in the developed world) appear to report estimates of sugars intake from national nutrition surveys at more than one point in time. Definitions of dietary sugars that were used include 'total sugars', 'non-milk extrinsic sugars', 'added sugars', 'sucrose' and 'mono- and disaccharides'. This variability in terminology across countries meant that comparisons were limited to within countries. Hence trends in dietary sugars intake were examined by country for the whole population (where data permitted), and for specific or combined age and sex subpopulations. Findings indicate that in the majority of population comparisons, estimated dietary sugars intake is either stable or decreasing in both absolute (g/d) and relative (% energy) terms. An increase in sugars intake was observed in few countries and only in specific subpopulations. In conclusion, the findings from the present review suggest that, in the main, dietary sugars intake are decreasing or stable. A consistent approach to estimation of dietary sugars intake from national nutrition surveys is required if more valid estimates of changes in dietary sugars intakes are required in the future.

Key words: Dietary intakes: Sugar: National nutrition surveys

Introduction

Dietary sugars intake has gained prominence as a highly controversial subject in regard to public health^(1,2). Although government and health organisations worldwide have issued dietary guidelines for sugars intake, these guidelines vary considerably. Guidelines typically take the form of either quantitative targets or qualitative advice and tend to differ regarding: the type and amount of sugars recommended; the procedures used to establish the evidence base; and the health outcome(s) on which the evidence may be based⁽³⁾. Examples of quantitative guidelines range from: added sugars should not exceed a maximum of half of the discretionary energy allowance from the American Heart Association⁽⁴⁾; a maximum 10% energy from free sugars from the WHO⁽⁵⁾; a maximum of 25% energy from added sugars from the Institute of Medicine⁽⁶⁾; through to the European Food Safety Authority being unable to set a dietary reference value for (added) sugar due to insufficient data⁽⁷⁾. It is expected that these guidelines will be further updated in 2014, as

draft guidelines have recently been issued by the WHO for public consultation⁽⁸⁾, and policy in relation to sugars intake is also being reviewed in the UK⁽⁹⁾. Estimates of population sugars intake can be compared with guidelines by the routine monitoring of food intake using indirect or direct methods of assessment. Indirect methods include examination of supply or availability data (for example, food balance sheets and household budget surveys), whereas direct assessments include food diary or record methods, diet histories, FFQ or 24 h recall by the individual. With regard to sugars intake, supply data have been reliably collated by the FAO since 1961⁽¹⁰⁾. These data indicate that, between 1961 and 2009, world total food energy supply (corrected for population numbers) has progressively increased by about 2510 kJ/capita per d (600 kcal/capita per d). Supply of sugars and sweeteners accounts for about 5% of this increase (126 kJ/capita per d (+30 kcal/capita per d))⁽¹⁰⁾. These data provide an indication of per capita availability of sugars; however, they do not account for wastage, which may be significant, particularly in developed countries, nor can they inform on

Abbreviation: NMES, non-milk extrinsic sugars.

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estimated actual consumption in individuals or specific subpopulations^(10,11). Furthermore, supply data are limited to estimating refined sugar (sucrose), or 'added' sugars and sweeteners (added to food/drinks by food manufacturers or independently by individuals), and therefore cannot be used to estimate the availability of total sugars, i.e. including sugars naturally present in fruits, vegetables and dairy products.

Direct assessment methods, on the other hand, estimate actual food consumption and can be employed at the individual level and then aggregated to provide summary data at subpopulation or population level. To the best of our knowledge, very few authors have attempted to use national food consumption data to examine trends in dietary intake of sugars in individual countries^(12–14). Stephen *et al.*⁽¹²⁾ examined trends in carbohydrate and components of carbohydrate intake in North America and the UK. However, this review was undertaken nearly two decades ago, and was compiled from a variety of published studies that reported sugars intake in various population groups, but were not necessarily nationally representative samples. More recently, Barclay & Brand-Miller⁽¹⁴⁾ reported small increases in estimated total sugars intake using dietary intake data for Australian adults and children/adolescents, although, again, the data for adults were gathered nearly two decades ago, and Welsh *et al.*⁽¹³⁾ reported that both absolute and relative estimated intakes of added sugars have decreased in the US population between the years 1999–2000 and 2007–2008. A recent review of nutritional surveillance systems indicates that a number of countries in the developed world have now undertaken national surveys of dietary intake in individuals at more than one time point⁽¹⁵⁾. Therefore, the purpose of the present review was to investigate within-country trends in dietary sugars intake using published data arising from national nutrition surveys. Where data allowed comparison, the review also examined the relationship between supply data (i.e. from the FAO) and estimated population intakes (i.e. dietary survey data) with regard to sugars.

Methods

Selection of data

A recent review of dietary surveys in the developed world was employed to identify countries and surveys within countries, which had undertaken multiple national nutrition surveys, and which might contain data to contribute to the present review⁽¹⁵⁾. The results of these surveys, which were published in government reports or as scientific papers in peer-reviewed journals, and which documented dietary sugars intake, were accessed where possible. No trend data were available for the developing world⁽¹⁶⁾. Data were only included for a country if all the following criteria were met: (a) the results of more than one survey had been published for a specific population

within that country; (b) where reporting of results was comparable with respect to category of sugars, sex and age group; and (c) where surveys had analysed dietary intake at the individual level. Surveys were included, regardless of dietary assessment methodologies (for example, FFQ, diet histories or recalls, and food diaries), or other differences in survey methodologies (for example, difference in the number of days assessed), or changes in population demographics (for example, slight differences in age ranges reported, or ethnic representation). Where a dietary survey had been undertaken, but where sugars intake had not been reported, no further investigation was undertaken by the authors to determine sugars intake and that survey was not included.

Analysis and presentation of results

Mean or median results are summarised by country within age group and sex where available. The distribution of dietary intakes of sugars is illustrated, where available, with 95% CI, standard deviations or standard errors of the mean as reported in the original reports. To allow consistency between results, all energy intakes are reported in MJ/d. Where energy intake was originally reported in kcal/d, this was converted to MJ/d using a conversion factor of $\times 0.00418$. Where % energy from sugars was not provided, this was calculated using a conversion factor of 1g sugar providing 16kJ energy. Due to differences between dietary assessment methodologies and population demographics there was no attempt to undertake statistical tests to analyse trends or differences. Apparent changes or trends were merely inferred from the data. However, where authors had already attempted to statistically analyse differences or trends in dietary sugars intakes these differences or trends have been reported.

Comparison with supply data

Where a country presented trends in dietary intake data for 'added sugars' or sucrose, and for all individuals (i.e. total population, regardless of age or sex), the intake data were compared with FAO supply data (FAOstat⁽¹⁰⁾) for the same time period.

Results

Reports for multiple national nutrition surveys, providing estimates of the population dietary intake of sugars, were accessed for thirteen countries, comprising ten European countries, together with Australia, New Zealand and the USA. Although multiple surveys have reportedly been undertaken in Belgium, Canada and South Korea⁽¹⁵⁾, we were unable to locate publicly available reports or data on sugars intake which met the inclusion criteria and could contribute to the present review. As already stated, multiple surveys appear to have not been undertaken,

Table 1. Direction of change in absolute sugar(s) intake together with magnitude of change (g/individual per d) and time span of surveys (years)

Country	Category of sugar(s)	Direction of change (change in g/d, time span of surveys in years)					
		All age groups combined			Children/adolescents		
		Male	Female	Combined	Male	Female	Combined
Australia	Total sugars	↑ then ↓ Overall (0, 29)	↑ then ↓ Overall (+2, 29)	↓ (-12, 17)	↓ (†)	↓ (†)	↓ (†)
Austria	Sucrose	↓ (-5, 11)	↓ (-6, 11)				
Denmark	Added sugars	↓ (-7, 20)	↓ (-7, 20)				
Finland	Sucrose	↑ (†)	↑ (†)				
France†	Sugars	↑ (†)	↑ (†)				
Germany	Sucrose	↑ (†)	↑ (†)				
Germany	Mono- and disaccharides	↓ (-14, 9)	↔				
Ireland	Total sugars			↓ (-6, 13)			
New Zealand†	Sucrose	↑ then ↓ Overall (+13, 20)	↑ then ↓ Overall (+15, 20)				
Norway	Added sugars	↓ (-18, 14)	↓ (-10, 14)				
Norway	Total sugars	↑ (+8, 22)	↑ (+2, 22)				
Sweden	Sucrose	↑	↑				
The Netherlands	Mono- and disaccharides	↓ (-8, 23)					
UK	Total sugars	↓ (†)	↓ (†)				
UK	NMES	↓ (†)	↓ (†)				
USA‡	Added sugars	↑ then ↓ Overall (0, 37)	↑ then ↓ (†)				

NMES, non-milk extrinsic sugars; †, sugar(s) intake has increased; ↓, sugar(s) intake has reduced; ↔, sugar(s) intake has remained stable.

‡ Inconsistent changes across age groups.

† Changes are supported by statistical comparison.

as yet, in developing countries⁽¹⁶⁾. While the sugars categorisation varied by country, the categorisation appeared, in the main, to remain constant within a country for successive surveys with some exceptions. In the USA, the category of added sugars has been adopted in preference to that of total sugars in surveys since the late 1990s. In addition, the definitions of both categories have changed to encompass a wider range of nutritive sweeteners (for example, various syrups, including corn syrup and high-fructose corn syrup). Due to this dramatic change in sugars definition, an early US report did not meet with our inclusion criteria and was therefore excluded from our investigation⁽¹⁷⁾. Both total sugars and non-milk extrinsic sugars (NMES) are reported in the UK. In the UK, NMES includes the sugars in fruit juice and 50% of the sugars in canned, stewed, dried or preserved fruits⁽¹⁸⁾, and intake is therefore usually greater than most definitions of 'added sugars' but less than that of total sugars. In addition, both sucrose and mono- and disaccharides have been reported in Germany, allowing the possibility of different changes/trends for these categorisations. The definition of relative energy from sugars also varied, being estimated relative to total energy in most countries and surveys, although some reported intakes relative to food energy (i.e. excluding alcohol) and these are indicated in the tables. The method of dietary analysis varied, with the majority of surveys employing 24 h recall (about 44%) or dietary records (about 39%), but with some surveys using diet history (about 8%) or FFQ (about 8%). The method of dietary analysis employed within countries in their dietary surveys also changed for most, though not all, countries over time. Analysis of trend data (i.e. from the earliest to the most recent survey) for countries ranged from 9 to 37 years, with the earliest included survey being undertaken in the USA in 1971–1975, and with inclusion of the most recent surveys for Australia and the UK (2011–2012).

Tables 1 and 2 summarise, for each country and population subgroup, the apparent direction and magnitude of change in absolute and relative intake of dietary sugars for the number of years spanned by successive surveys. The direction and magnitude of change are based on country-specific data, the detail for which can be found in Tables 3–9 for all individuals, adults (men and women combined), adult men, adult women, children/adolescents (males and females combined), male children/adolescents and female children/adolescents, respectively. Statistical comparisons between intakes in successive surveys have been undertaken for four countries (Australia, France, New Zealand and the USA).

Changes and trends on an absolute basis

Of the forty-nine possible country-, population- and category-specific comparisons which could be made on an absolute intake basis (g/d; Table 1), estimated intake

Table 2. Direction of change in relative intake of dietary sugar(s) together with magnitude of change (% point change) and time span of surveys (years)

Country	Category of sugar(s)	Direction of change (% point change in % energy, time span of surveys in years)					
		All age groups combined			Children/adolescents		
		Adults		Combined	Children/adolescents		Combined
Male	Female	Male	Female				
Australia	Total sugars	↑ (+2, 29)	↔	↓ (-1, 17)	↑	↑	
Austria	Sucrose	↔	↓ (-2, 14)				
Denmark	Added sugars	↔	↔	↔			
Finland	Sucrose	↔	↓ (-1, 20)		↓ (-3, 11)	↓ (-2, 11)	
France‡	Sugars	↔					
Germany	Sucrose						
Germany	Mono- and disaccharides	↓ (-1, 9)	↔				
Ireland	Total sugars						
New Zealand	Sucrose	↑ (+2, 20)	↑ (+2, 20)	↔			
Norway	Added sugars	↓ (-2, 14)	↓ (-2, 14)	↓ (-2, 18)		↓ (†)	
Sweden	Sucrose	↑ (+1, 22)	↑ (+1, 22)				
The Netherlands	Mono- and disaccharides	↑	↑		↑	↑	
UK	Total sugars	↑	↑ (†)		↓ (†)	↓ (†)	
UK	NMES	↑	↑		↑	↑ (†)	
USA‡	Added sugars	↓ (†)	↓ (†)	↑ then ↓ (†)		↑ then ↓ (†)	
	All age groups combined	↑ then ↓ Overall (0, 37)					

NMES, non-milk extrinsic sugars; †, sugar(s) intake has increased; ↔, sugar(s) intake has remained stable; ↓, sugar(s) intake has reduced.

‡ Inconsistent changes across age groups.

‡ Changes are supported by statistical comparison.

of dietary sugars (irrespective of the categorisation) increased in seven comparisons, decreased in twenty-six comparisons, and remained relatively stable in one comparison. Dietary sugars intake increased before a subsequent decrease in seven comparisons, and with inconsistent findings by age-group subcategories in eight comparisons. Consistent trends, in terms of direction of change, and regardless of age or sex, were observed in Denmark, Finland and Norway where estimates of absolute intakes of dietary sugars appear to have decreased, in France where estimates of intakes have increased, and in the USA and New Zealand where intakes increased before a subsequent decrease. The direction of change in absolute intake of dietary sugars intake varied between age groups and/or sex for all other countries.

Where data were reported for both sexes and all age groups combined, sugars intake has decreased in The Netherlands, and increased and then decreased in the USA (zero overall change). In adults, when reported for both sexes combined, sugars intake decreased in Australia, Denmark, Ireland and Norway, and increased and then decreased in the USA (overall change varied by age group). In adult males, sugars intake increased in France, Germany (sucrose) and Sweden; decreased in Denmark, Finland, Germany (mono- and disaccharides), Norway and the UK (both for total sugars and NMES); and increased and then decreased in Australia (zero overall change) and New Zealand (overall positive change). In adult females, the category of sugars intake increased in France and Germany (sucrose); decreased in Denmark, Finland and Norway; remained stable in Germany (mono- and disaccharides), Sweden and the UK (NMES); and increased and then decreased in Australia and New Zealand (both overall positive change). In children/adolescents, sugars intake for both sexes combined decreased in Australia, Denmark and Norway, and increased and then decreased in the USA (overall change varied by age group). Sugars intake decreased in Australian, Danish and UK children/adolescents (both total sugars and NMES) when reported separately by sex, and in female German adolescents. Sugars intake increased in male German adolescents.

There were only four countries that reported dietary intake of what are considered to be added sugars (NMES in the UK). In Denmark, Norway and the USA, estimated intake of added sugars decreased, although in the USA this decrease occurred following a prior increase. In the UK, most estimates of NMES intake decreased, although findings are inconsistent in some sex/age group combinations.

The magnitude of change and the time span covered by successive surveys varied widely (see Table 1), with the largest increase apparent in New Zealand adult females (estimated 15 g increase over a 20-year period for sucrose). The largest overall decrease seems to have occurred in Norway, with an apparent 18 g decrease in added sugars

Table 3. Energy and 'sugars' intake for all individuals ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	sd or se	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
The Netherlands	1987–1988	Mono- and disaccharides	1–85	5898	9.7	128	SD 54	22.5	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	1–92	6218	9.3	122	SD 53	22.5	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	1–97	5958	9.2	125	SD 53	23.3	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	7–69	3819	9.5	120	SD 56	21.3	VCP	2 x 24 h recalls	28
USA	1971–1975	Added sugars	1–74	20 195	8.3	77		14.8	NHANES I	24 h dietary recall	29
	1988–1994	Added sugars	1–90	28 663	8.9	86		15.5	NHANES III	24 h dietary recall	29
	1994–1996	Added sugars	≥ 2	15 010		82		15.8	CSFII	24 h dietary recall	30
	1999–2000	Added sugars	≥ 2	8070	9.0	100	SE 3.4	18.1	NHANES	24 h dietary recall	13
	2001–2002	Added sugars	≥ 2	9032	9.1	94	SE 1.9	17.1	NHANES	24 h dietary recall	13
	2003–2004	Added sugars	≥ 2	8273	9.2	88	SE 1.7	15.9	NHANES	24 h dietary recall	13
	2005–2006	Added sugars	≥ 2	8501	9.0	80	SE 2.0	14.5	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	≥ 2	8435	8.6*	77***	SE 2.4	14.6	NHANES	24 h dietary recall	13

VCP, Voedselconsumptiepeilingen; NHANES, National Health and Nutrition Examination Survey; CSFII, Continuing Survey of Food Intake by Individuals. Significant linear trend during the five 2-year NHANES cycles from 1999–2000 to 2007–2008: * $P < 0.05$, ** $P < 0.001$, *** $P < 0.0001$.

for adult males over a 14-year period. However, the estimated intake of added sugars has also apparently fallen by 23 g over the last 9 years in the USA.

Changes and trends on a relative basis

Of the forty-four possible comparisons that could be made on a relative basis (% energy; Table 2), increasing % energy from dietary sugars was apparent in six comparisons, with decreasing % energy from dietary sugars in seventeen comparisons, and apparent stability in eight comparisons. Findings were inconsistent for age-group subcategories in ten comparisons. The % energy from dietary sugars increased before decreasing again in three comparisons. The direction of change in relative intake of dietary sugars was only consistent across both sexes and for all age groups (adults and children/adolescents) in New Zealand and Sweden (both increased), Norway (decreased) and the USA (increased and then decreased). The direction of change in relative intake of dietary sugars varied between age groups and/or sex for all other country comparisons.

In the countries that reported intake as added sugars (NMES in the UK), with the exception of adult women aged 65+ years, where estimated intake of NMES has increased by less than 1% energy, estimated % energy from added sugars decreased or remained stable.

In relative energy terms, the magnitude of change and the time span covered by successive surveys varied widely (see Table 2), with the largest increase (2% points) apparent in Australian adult males (over a period of 25 years) and New Zealand adult males and females (over a period of 20 years). The largest decreases were apparent in Danish male children/adolescents (3% points decrease over 11 years). The estimated intake of added sugars has also decreased, over more recent years, in the US population (3% points decrease in added sugars over 9 years). Although the direction of change for the dietary intake of sugars was comparable in absolute and relative terms in some countries (Norway and the USA), in all other countries there was no consistent agreement between the directions of change in relative and absolute terms.

Comparison with supply data

The USA was the only country that reported dietary intake data in a form (i.e. for the total population and as 'added sugar' or 'sucrose') that could allow comparison with supply data. By our approximations, simultaneous US supply data as reported to the FAO appear to exceed estimates of absolute intake by about 100%. Estimated intake and supply data appeared closer in magnitude when reported in relative terms (% energy); however, a simple Pearson correlation revealed no relationship between dietary intake and supply data in either absolute ($r = 0.46$; $P > 0.1$) or relative ($r = 0.32$; $P > 0.1$) terms.

Table 4. Energy and ‘sugars’ intake for adults (men and women combined) ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	SD or SE	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
Australia	1995	Total sugars	19 +	10 851	9.2	115		20.2	National Nutrition Survey	24 h dietary recall	31
	2011–2012	Total sugars	19 +		8.7	103	1.0†	19.2	Australian Health Survey	24 h dietary recall	32
Denmark	1985	Added sugars	15–80	2242	11.3	59		8	Danskernes kostvaner 1985	Diet history questionnaire (28 d)	33
	1995	Added sugars	15–75	1746	10.2	54		9‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2000–2002	Added sugars	15–75	3297	9.5	53		10‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2003–2006	Added sugars	15–75	2578	9.1	48		9‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
Ireland	1997–1999	Total sugars	18–64	1379	9.3	98	SD 46	16.6	NSIFCS	7 d dietary record	35
	2008–2010	Total sugars	18–64	1274	8.3	92	SD 44	16.6	National Adult Nutrition Survey	4 d dietary record	36
Norway	1993–1994	Added sugars	16–79	3144	9.5	55		9	Norkost 1	Semi-quantitative FFQ	37
	1997	Added sugars	16–79	2672	9.4	56		9.3	Norkost 2	Semi-quantitative FFQ	37
	2010–2011	Added sugars	18–70	1787	9.4	42	SD 38	7.3	Norkost 3	2 × 24 h dietary recall	38
USA	1971–1975	Total sugars	19+	13 105	8.2	110		21.5	NHANES I	24 h dietary recall	29
	1988–1994	Total sugars	19+	48 159	9.2	126		21.9	NHANES III	24 h dietary recall	29
	1971–1975	Added sugars	19 +	13105	8.2	71		13.9	NHANES I	24 h dietary recall	29
	1988–1994	Added sugars	19 +	48159	9.2	84		14.6	NHANES III	24 h dietary recall	29
	1999–2000	Added sugars	18–34	1635	10.3	132	SE 6.1	21.4	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	18–34	1518	9.5***	92**	SE 4.1	16.3***	NHANES	24 h dietary recall	13
	1999–2000	Added sugars	35–54	1343	9.2	93	SE 5.1	16.7	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	35–54	1832	9.4	81*	SE 3.5	14.3*	NHANES	24 h dietary recall	13
	1999–2000	Added sugars	≥ 55	1758	7.8	65	SE 1.8	13.3	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	≥ 55	2286	7.6***	55	SE 1.4	11.8**	NHANES	24 h dietary recall	13

NSIFCS, North/South Ireland Food Consumption Survey; NHANES, National Health and Nutrition Examination Survey.
 Significant linear trend during the five 2-year NHANES cycles from 1999–2000 to 2007–2008: * $P < 0.05$, * $P < 0.01$, *** $P < 0.001$.
 † Relative standard error of estimate (%).
 ‡ Percentage food energy (excluding energy from alcohol).

Table 5. Energy and 'sugars' intake for adult men ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	95% CI, SD or SE	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
Australia	1983	Total sugars	25–64	3021	10.8	115	95% CI 112, 117	17.0	National Dietary Survey of Adults	24 h dietary recall	39
	1995	Total sugars	19 +	5081	11.0	134		19.4	National Nutrition Survey	24 h dietary recall	31
Austria	2011–2012	Total sugars	19 +		10.0	115	1.5†	18.6	Australian Health Survey	24 h dietary recall	32
	1998	Sucrose	18–64					9	ASNS	24 h dietary recall	40
	2003	Sucrose	18–64					10	ASNS	24 h dietary recall	40
	2008	Sucrose	18–64	NR				9	ASNS	24 h dietary recall	40
	2012	Sucrose	18–64	168				9	ASNS	24 h dietary recall	40
Denmark	1995	Added sugars	15–75	849	11.7	59		9‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2000–2002	Added sugars	15–75	1626	10.8	57		9‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2003–2006	Added sugars	15–75	1184	10.5	54		9‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
Finland	1992	Sucrose	25–64	870	10.4	58	SD 37	9.0	The 1992 Survey of Finnish Adults	3 d dietary record	41
	1997	Sucrose	25–64	1361	9.5	54		9.7	The 1997 Survey of Finnish Adults	24 h recall	42
	2002	Sucrose	25–64	912	9.2	49	SD 33	9.1	FINDIET	48 h recall	43
	2007	Sucrose	25–64	730	9.2	54	SD 37	9.7	FINDIET	48 h recall	44
	2012	Sucrose	25–64	585	9.4	51	SD 35	9.2	FINDIET	48 h recall	45
France	1993–1994	Sugars	18–65 +	357	9.7	70	SD 30	12.0‡	ASPPC	7 d dietary record	46
	1998–1999	Sugars	18–34	180	10.6	108	SD 46	16.3	INCA 1	7 d dietary record	47
	2006–2007	Sugars	18–34	178	10.6	119**	SD 56	18.0	INCA 2	7 d dietary record	47
	1998–1999	Sugars	35–54	245	10.5	95	SD 40	14.4	INCA 1	7 d dietary record	47
	2006–2007	Sugars	35–54	354	10.5	99 ^{NS}	SD 42	15.1	INCA 2	7 d dietary record	47
	1998–1999	Sugars	55–79	188	10.0	92	SD 38	14.7	INCA 1	7 d dietary record	47
	2006–2007	Sugars	55–79	308	10.0	90 ^{NS}	SD 43	14.4	INCA 2	7 d dietary record	47
	1985–1989	Sucrose	19–24	748		61§			NVS	7 d dietary record	48
	2005–2007	Sucrose	19–25	469		64§			NVS II	24 h recall	
	1985–1989	Sucrose	51–64	1218		38§			NVS	7 d dietary record	48
Germany	2005–2007	Sucrose	51–65	1460		51§			NVS II	24 h recall	
	1985–1989	Sucrose	> 64	739		39§			NVS	7 d dietary record	48
	2005–2007	Sucrose	65–80	1165		51§			NVS II	24 h recall	
	1998	Monosaccharides	18–79	1763	About 11.0	About 85			The German Nutrition Survey	Diet history	49
	1998	Disaccharides	18–79	1763	About 11.0	About 53			The German Nutrition Survey	Diet history	49
	2005–2007	Mono- and disaccharides	14–80	7093	10.7	124		18.5	NVS II	Diet history	50
	1989	Sucrose	15 +	796	10.2§	42§		6.6	Life in New Zealand	24 h dietary recall	51
	1997	Sucrose	15 +	1927	12.0§	62§	95% CI 60, 64	8.3	New Zealand Adult Nutrition Surveys	24 h dietary recall	52
	2008–2009	Sucrose	15 +	2066	10.7*§	55*§	95% CI 51, 59	8.2	New Zealand Adult Nutrition Surveys	24 h dietary recall	52
	Norway	1997	Added sugars	16–79	1298	10.9	66		9.5	Norkost 2	Semi-quantitative FFQ
Sweden	2010–2011	Added sugars	18–70	862	10.9	48	SD 43	7.2	Norkost 3	2 × 24 h dietary recalls	53
	1989	Sucrose	18–74	769	9.6	45		7.7	Hulk	7 d dietary record	38
	1997–1998	Sucrose	18–74	589	9.9	51		8.5	Riksmaten	7 d dietary record	53
The Netherlands	2010–2011	Sucrose	18–80	792	9.4	53	SD 32	9.4	Riksmaten	4 d dietary record	54
	1987–1988	Mono- and disaccharides	16–19	143	12.9	181	SD 71	23.6	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	16–19	128	11.6	163	SD 53	23.9	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	16–19	142	11.6	170	SD 63	24.9	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	16–19	208	11.5	159	SD 62	23.7	VCP 2007–10	2 × 24 h recall	28
	1987–1988	Mono- and disaccharides	19–22	88	12.4	157	SD 66	21.6	VCP-1	2 d dietary record	28
	1992	Mono- and disaccharides	19–22	111	12.0	173	SD 64	24.2	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	19–22	130	11.9	163	SD 62	23.4	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	19–22	66	12.1	167	SD 92	23.3	VCP 2007–10	2 × 24 h recall	28
	1987–1988	Mono- and disaccharides	22–50	1230	11.8	141	SD 57	20.0	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	22–50	1306	11.3	134	SD 56	19.7	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	22–50	1252	11.2	139	SD 59	20.9	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	22–50	609	11.4	134	SD 64	19.7	VCP 2007–10	2 × 24 h recall	28
	1987–1988	Mono- and disaccharides	50–65	386	10.7	126	SD 52	19.7	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	50–65	405	10.5	123	SD 54	19.5	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	50–65	454	10.4	123	SD 52	19.8	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	50–65	289	10.4	109	SD 48	17.6	VCP 2007–2010	2 × 24 h recall	28
	1987–1988	Mono- and disaccharides	65 +	226	10.3	125	SD 56	20.2	VCP-1	2 d dietary record	28
	1992	Mono- and disaccharides	65 +	236	9.7	119	SD 43	20.8	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	65 +	185	9.4	117	SD 46	20.8	VCP-3	2 d dietary record	27
2007–2010	Mono- and disaccharides	65–69	91	9.4	100	SD 43	18.0	VCP 2007–2010	2 × 24 h recall	28	

Table 5. Continued

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	95% CI, SD or SE	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
UK	1986–1987	Total sugars	16–64	1087	10.2	115	SE 1.5	18.0	The Dietary and Nutritional Survey of British Adults	7 d dietary record	55
	2000–2001	Total sugars	19–64	833	9.7	119	SD 55	20.6†	NDNS	7 d dietary record‡	56
	2008–2009/2011–2012	Total sugars	19–64	1126	8.9	106	SD 48	19.8‡	NDNS	4 d dietary record	57
	1994–1995	Total sugars	65+	632	8.0	103	SD 43	21.0†	NDNS Older Adults (free living)	4 d dietary record	58
	2008–2009/2011–2012	Total sugars	65+	317	8.1	102	SD 47	20.6‡	NDNS	4 d dietary record	57
	2000–2001	NMES	19–64	833	9.7	78	SD 47	13.5‡	NDNS	7 d dietary record‡	56
	2008–2009/2011–2012	NMES	19–64	1126	8.9	68	SD 42	12.7‡	NDNS	4 d dietary record	57
	1994–1995	NMES	65+	632	8.0	64	SD 38	13.0‡	NDNS Older Adults (free living)	4 d dietary record	58
	2008–2009/2011–2012	NMES	65+	317	8.1	59	SD 40	11.6‡	NDNS	4 d dietary record	57

NR, not reported; ASNS, Austrian Study on Nutritional Status; ASPCC, French Association Sucre Produits Sucrés Consommation et Communication; INCA, Individuelle Nationale des Consommations Alimentaires; NS, not significantly different to previous survey; NVS, German National Food Consumption Survey; VCP, Voedselconsumptiepeilingen; NDNS, National Diet and Nutrition Survey; NMES, non-milk extrinsic sugars.

Mean value was significantly different from the previous survey: * $P < 0.05$; ** $P < 0.01$.

† Relative standard error of estimate (%).

‡ Percentage food energy (excluding energy from alcohol).

§ Median value.

|| Results have been estimated based on not significantly different results reported for adult males sampled in East and West parts of Germany separately.

¶ Reanalysed to provide estimates for 4 d to allow comparison with later surveys.

Discussion

A number of developed countries have now undertaken multiple national nutrition surveys, which allowed us to investigate trends in dietary sugars intake. The main finding of the present review was that in the majority of age group/sex combinations, where comparisons could be made, estimates of mean population sugars intake appear to have been stable or decreasing. In a relatively small subset of country-, age- and sex-specific subpopulations intakes may have increased. Although it was possible to investigate trends within a country, differences in categorisation and definitions of sugars, dietary assessment methodologies, and age/sex reporting categories employed between countries made it difficult to draw broader conclusions.

Data were available for thirteen countries where multiple national nutrition surveys have been undertaken and which included analysis on dietary sugars intake. With regard to specific country, sex and age groups, dietary intake of sugars appeared to be stable or have decreased in 55% of absolute and 57% of relative (energy-adjusted) comparisons. Absolute increases ranged from 2 g/d over a 10-year period in Swedish adult females to 15 g/d over a 20-year period in New Zealand adult females. Such changes resulted in relative increases that ranged up to a maximum 2% points increase in Australian adult males (over a period of 29 years) and New Zealand adults (over a period of 20 years). In contrast, dietary intake of sugars appears to have increased in 14% of comparisons when examined either by absolute or relative intake. Absolute decreases ranged from 1 g/d in German female children/adolescents over a period of 22 years to 18 g/d in male Norwegian adults over a period of 14 years. Relative decreases ranged up to a 3% points decrease in male Danish children/adolescents over a period of 11 years. The remainder of the comparisons increased and then decreased or varied in direction by subgroup of age. In countries that specifically reported intake as ‘added sugars’ (Denmark, Norway and the USA) intakes appear to be decreasing in absolute terms, and decreasing or stable in relative terms. Estimated NMES intake in the UK is slightly less consistent, although in general intakes are decreasing or stable. The adolescent population is frequently considered to be of particular concern regarding their dietary sugars intake, as they have reported the highest intake of sugars in some countries⁽¹⁹⁾. Although the dietary intake of sugars may have increased in some adolescent population groups (Dutch males), it has reduced in others (Denmark, USA, UK males and Dutch females).

There was relatively little agreement between direction of change in dietary sugars intake in absolute and relative terms, which indicates that energy intakes from other energy-providing nutrients are also changing. It was outside the scope of the present review to report on these other changes, which undoubtedly also vary by country,

Table 6. Energy and 'sugars' intake for adult women ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	95% CI or SD	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
Australia	1983	Total sugars	25-64	3233	7.3	89	95% CI 87, 91	19.5	National Dietary Survey of Adults	24 h dietary recall	39
	1995	Total sugars	19+	5770	7.5	97		20.9	National Nutrition Survey	24 h dietary recall	31
	2011-2012	Total sugars	19+		7.4	91	1-11	19.8	Australian Health Survey	24 h dietary recall	32
Austria	1998	Sucrose	18-64	NR				12	ASNS	24 h dietary recall	40
	2003	Sucrose	18-64	NR				11	ASNS	24 h dietary recall	40
	2008	Sucrose	18-64	NR				11	ASNS	24 h dietary recall	40
	2012	Sucrose	18-64	251				10	ASNS	24 h dietary recall	40
	1995	Added sugars	15-75	897	8.8	48		9†	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
Denmark	2000-2002	Added sugars	15-75	1771	8.4	50		10†	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2003-2006	Added sugars	15-75	1394	7.9	42		9†	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
Finland	1992	Sucrose	25-64	991	7.8	50	SD 30	11.0	The 1992 Survey of Finnish Adults	3 d dietary record	41
	1996	Sucrose	25-64	1501	6.8	42		10.1	The 1997 Survey of Finnish Adults	24 h recall	42
	2002	Sucrose	25-64	1095	6.6	43	SD 26	10.8	FINDIET	48 h recall	43
	2007	Sucrose	25-64	846	6.8	43	SD 26	10.5	FINDIET	48 h recall	44
	2012	Sucrose	25-64	710	7.3	43	SD 28	10.0	FINDIET	48 h recall	45
France	1993-1994	Sugars	18-65+	533	7.6	58	SD 26	12.6†	ASPPC	7 d dietary record	46
	1998-1999	Sugars	18-34	286	8.2	94	SD 37	18.3	INCA 1	7 d dietary record	47
	2006-2007	Sugars	18-34	280	8.1	94 ^{NS}	SD 35	18.6	INCA 2	7 d dietary record	47
	1998-1999	Sugars	35-54	270	8.0	85	SD 32	17.0	INCA 1	7 d dietary record	47
	2006-2007	Sugars	35-54	477	8.1	95*	SD 29	18.8	INCA 2	7 d dietary record	47
	1998-1999	Sugars	55-79	196	7.7	86	SD 30	17.9	INCA 1	7 d dietary record	47
	2006-2007	Sugars	55-79	325	7.9	90 ^{NS}	SD 29	18.2	INCA 2	7 d dietary record	47
	1985-1989	Sucrose	19-24	972		53§			NVS	24 h recall	48
	2005-2007	Sucrose	19-25	469		56§			NVS II	24 h recall	48
	1985-1989	Sucrose	51-64	1503		40§			NVS	7 d dietary record	48
New Zealand	2005-2007	Sucrose	15+65	1460		49§			NVS II	24 h recall	48
	1985-1989	Sucrose	>64	898		38§			NVS	7 d dietary record	48
	2005-2007	Sucrose	65-80	1165		48§			NVS II	24 h recall	48
	1998	Mono-saccharides	18-79	2267	7.9	About 67		About 13.6	The German Nutrition Survey	Diet history	49
	1998	Disaccharides	18-79	2267	8.0	About 7.9		About 8.8	The German Nutrition Survey	Diet history	49
	2005-2007	Mono- and disaccharides	14-80	8278	8.0	113		22.6	German National Nutrition Survey II	Diet history	50
	1989	Sucrose	15+	906	6.7§	27§		6.4	Life in New Zealand	24 h dietary recall	51
	2008-2009	Sucrose	15+	2709	8.0§	45§	95% CI 43, 47	9.0	New Zealand Adult Nutrition Surveys	24 h dietary recall	52
	1997	Sucrose	15+	2655	7.6§	42§ ^{NS}	95% CI 40, 44	8.8	New Zealand Adult Nutrition Surveys	24 h dietary recall	52
	2008-2009	Added sugars	16-79	1374	8.0	46		9.1	Norkost 2	Semi-quantitative FFQ	37
Norway	2010-2011	Added sugars	18-70	925	8.0	36	SD 30	7.4	Norkost 3	2 x 24 h dietary recalls	38
	1989	Sucrose	18-74	804	7.4	42		9.4	Hulk	7 d dietary record	53
Sweden	1987-1988	Sucrose	18-74	626	7.8	42		9.0	Riksmaten	7 d dietary record	53
	2010-2011	Sucrose	18-80	1005	7.4	44	SD 27	9.7	Riksmaten	4 d dietary record	54
The Netherlands	1987-1988	Sucrose	16-19	166	9.4	135	SD 51	24.0	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	16-19	125	8.8	129	SD 53	24.7	VCP-2	2 d dietary record	27
	1989	Mono- and disaccharides	16-19	139	9.1	142	SD 53	26.2	VCP-3	2 d dietary record	27
	2007-2010	Mono- and disaccharides	16-19	209	8.5	124	SD 52	24.4	VCP 2007-2010	2 x 24 h recall	28
	1987-1988	Mono- and disaccharides	19-22	113	8.8	128	SD 46	24.0	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	19-22	107	8.6	120	SD 57	23.2	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	19-22	128	8.6	130	SD 54	25.4	VCP-3	2 d dietary record	27
	2007-2010	Mono- and disaccharides	19-22	61	8.4	122	SD 54	24.5	VCP 2007-2010	2 x 24 h recall	28
	1987-1988	Mono- and disaccharides	22-50	1341	8.7	109	SD 47	20.8	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	22-50	1493	8.4	104	SD 48	20.8	VCP-2	2 d dietary record	27
The Netherlands	1998	Mono- and disaccharides	22-50	1472	8.5	108	SD 47	21.3	VCP-3	2 d dietary record	27
	2007-2010	Mono- and disaccharides	22-50	616	8.4	109	SD 49	21.8	VCP 2007-2010	2 x 24 h recall	28
	1987-1988	Mono- and disaccharides	50-65	484	8.1	102	SD 43	20.9	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	50-65	545	7.8	97	SD 41	20.7	VCP-2	2 d dietary record	27
	1988	Mono- and disaccharides	50-65	512	7.8	97	SD 43	20.7	VCP-3	2 d dietary record	27
	2007-2010	Mono- and disaccharides	50-65	292	8.0	94	SD 42	19.6	VCP 2007-2010	2 x 24 h recall	28
	1987-1988	Mono- and disaccharides	65+	266	7.8	102	SD 41	21.7	VCP-1	2 d dietary record	27

Table 6. Continued

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	95% CI or SD	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
UK	1992	Mono- and disaccharides	65 +	263	7.7	99	SD 42	21.5	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	65 +	236	7.5	100	SD 38	22.3	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	65–69	82	7.5	92	SD 37	20.6	VCP 2007–2010	2 x 24 h recall	28
	1987–1988	Mono- and disaccharides	Pregnant women	52	9.4	134	SD 57	23.5	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	Pregnant women	58	8.8	125	SD 43	23.8	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	Pregnant women	50	8.9	130	SD 46	24.8	VCP-3	2 d dietary record	27
	1986–1987	Total sugars	16–64	1110	7.0	86		19.7	The Dietary and Nutritional Survey of British Adults	7 d dietary record	55
	2000–2001	Total sugars	19–64	891	6.9	89	SD 41	21.0†	NDNS	7 d dietary record‡	56
	2008–2009/2011–2012	Total sugars	19–64	1571	6.8	85	SD 39	20.5†	NDNS	4 d dietary record	57
	1994–1995	Total sugars	65 +	643	6.0	79	SD 34	21.0†	NDNS Older Adults (free living)	4 d dietary record	58
2008–2009/2011–2012	Total sugars	65 +	436	6.4	88	SD 35	22.3‡	NDNS	4 d dietary record	57	
2000–2001	NMES	19–64	891	6.9	52	SD 35	12.0†	NDNS	7 d dietary record‡	56	
2008–2009/2011–2012	NMES	19–64	1571	6.8	49	SD 35	11.6†	NDNS	4 d dietary record	57	
1994–1995	NMES	65 +	643	6.0	44	SD 27	11.3‡	NDNS Older Adults (free living)	4 d dietary record	58	
2008–2009/2011–2012	NMES	65 +	436	6.4	46	SD 26	11.5‡	NDNS	4 d dietary record	57	

NR, not reported; ASNS, Austrian Study on Nutritional Status; ASPCC, French Association Sûre Produits Sucrés Consommation et Communication; INCA, Individuelle Nationale des Consommations Alimentaires; NS, not significantly different to previous survey; NVS, German National Food Consumption Survey; VCP, Voedselconsumptiepeilingen; NDNS, National Diet and Nutrition Survey; NMES, non-milk extrinsic sugars.

* Mean value was significantly different from previous survey ($P < 0.05$).

† Relative standard error of estimate (%).

‡ Percentage food energy (excluding energy from alcohol).

§ Median value.

|| Results have been estimated based on not significantly different results reported for adult males sampled in East and West parts of Germany separately.

¶ Reanalysed to provide estimates for 4 d to allow comparison with later surveys.

sex and age group. However, as dietary guidelines are frequently presented in % energy terms, any change in a particular energy-providing nutrient in % energy terms may not necessarily reflect absolute changes in intake of that nutrient. For example, authors have reported that attempts to reduce dietary fat consumption in the USA have been successful with % energy from fat having decreased⁽²⁰⁾. However, closer examination of the data reveals that absolute fat intake (g) does not appear to have decreased, and the reduction in % energy from fat merely reflects the effects of an increase in absolute energy intake from other macronutrients (mainly total carbohydrates in this example)⁽²¹⁾.

The magnitude of change in dietary sugars intake, where it could be ascertained, also varied widely between countries, sexes and age groups. The method of dietary analysis, which was employed in countries, frequently varied over time. Small changes in dietary intake of sugars could be due to changes in the method of dietary analysis. However, some marked differences in sugars intake between earlier and later surveys were apparent in specific population groups in certain countries. These differences have been suggested to be due to methodological aspects in France⁽²²⁾ and a reduction in sugar-sweetened beverage intake in Norwegian children⁽²³⁾.

In contrast to total world food supply, per capita supply of both refined sugar (sucrose) and total sugars and sweeteners has been stable since the late 1970s (FAOstat)⁽¹⁰⁾. Supply data do not easily account for wastage, cannot inform on specific subpopulation intake, and their use in informing public health guidelines has been criticised in at least the USA⁽¹¹⁾. The USA was the only country that reported dietary intake data in a form that allowed comparison with supply data, i.e. reported data for added sugars intake for all individuals. By our approximations, simultaneous US supply data, as reported to FAO, may exceed estimated intake by about 100% and there appears to be no relationship ($P > 0.05$) between dietary intake and supply data in either absolute or relative terms. Although examination of trends in supply data may have its uses in forming research hypotheses and in ascertaining availability of nutrients to a population, a lack of, or poor, association between supply and estimates of actual consumption suggests greater caution should be exerted when using supply data as an interpretation of dietary intake.

There are a number of noteworthy limitations in this analysis of trends in dietary sugars intake. The data currently extend to relatively few countries in the developed world and, in some cases, cover somewhat short time periods (the shortest time period was 9 years for mono- and disaccharide intake in German adults). Therefore, the degree to which our findings may be considered worldwide is limited. The methods of assessing dietary intake also varied, with most surveys employing food diaries or 24 h recalls. An exception to this was Norway, which

Table 7. Energy and ‘sugars’ intake for children and/or adolescents (males and females combined) ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	SD or SE	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
Australia	1995	Total sugars	2–3	383	6.4	115		29.4	National Nutrition Survey	24 h dietary recall	31
	2007	Total sugars	2–3	1071	6.0	99		25.9	Australian National Children’s Nutrition and Physical Activity Survey	24 h dietary recall	59
	2011–2012	Total sugars	2–3		6.0	92	2.9‡	24.5	Australian Health Survey	24 h dietary recall	32
	2007	Total sugars	4–8	1216	7.2	112		24.3	Australian National Children’s Nutrition and Physical Activity Survey	24 h dietary recall	59
	2011–2012	Total sugars	4–8		7.1	103	2.2‡	23.5	Australian Health Survey	24 h dietary recall	32
	2007	Total sugars	9–13	1110	8.9	135		23.7	Australian National Children’s Nutrition and Physical Activity Survey	24 h dietary recall	59
Denmark	2011–2012	Total sugars	9–13		8.6	120	2.6‡	22.6	Australian Health Survey	24 h dietary recall	32
	1995	Added sugars	4–14	983	9.1	74		14§	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2000–2002	Added sugars	4–14	823	8.7	68		13§	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2003–2006	Added sugars	4–14	669	8.3	58		12§	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
Norway	1999	Added sugars	1	1231	5.5	32	SD 22	9.9§	Spedkost	FFQ	60
	2007	Added sugars	1	881	5.0	12	SD 14	4.0§	Spedkost	FFQ	60
	1999	Added sugars	2	1720	6.0	42	SD 25	11.7§	Småbarnskost	FFQ	23
	2007	Added sugars	2	1674	5.7	23	SD 16	6.9§	Småbarnskost	FFQ	23
UK	1983	Total sugars	10–15	3283	8.3	115		22.0	Diets of British Schoolchildren	7 d dietary record	24
	1997	Total sugars	10–15	459	7.8*	113		22.7***	NDNS	7 d dietary record	24
	1983	Total sugars	10–11	2057	8.0	117		23.1	Diets of British Schoolchildren	7 d dietary record	24
	1997	Total sugars	10–11	248	7.5*	113		23.4	NDNS	7 d dietary record	24
	1983	Total sugars	14–15	1226	8.9	113		20.2	Diets of British Schoolchildren	7 d dietary record	24
	1997	Total sugars	14–15	211	8.0*	113		21.8*	NDNS	7 d dietary record	24
USA	1971–1975	Total sugars	1–18	7090	8.4	138		26.3	NHANES I	24 h dietary recall	29
	1988–1994	Total sugars	1–18	12715	8.2	139		27.1	NHANES III	24 h dietary recall	29
	1971–1975	Added sugars	1–18	7090	8.4	88		16.8	NHANES I	24 h dietary recall	29
	1988–1994	Added sugars	1–18	12715	8.2	92		18.0	NHANES III	24 h dietary recall	29
	1999–2000	Added sugars	2–5	665	6.7	69	SE 4.8	17.0	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	2–5	823	6.4†	52†††	SE 1.2	13.4†††	NHANES	24 h dietary recall	13
	1999–2000	Added sugars	6–11	961	8.5	106	SE 6.6	20.6	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	6–11	1107	8.0	84††	SE 2.5	17.0†††	NHANES	24 h dietary recall	13
	1999–2000	Added sugars	12–17	1708	9.3	124	SE 4.8	22.3	NHANES	24 h dietary recall	13
	2007–2008	Added sugars	12–17	869	8.7††	90†††	SE 3.5	17.3†††	NHANES	24 h dietary recall	13

NDNS, National Diet and Nutrition Survey; NHANES, National Health and Nutrition Examination Survey.
 Mean value was significantly different from previous survey: * $P < 0.001$, ** $P < 0.01$, *** $P < 0.05$.
 Significant linear trend during the five 2-year NHANES cycles from 1999–2000 to 2007–2008: † $P < 0.05$, †† $P < 0.01$, ††† $P < 0.001$.
 ‡ Relative standard error of estimate (%)
 § Percentage food energy (excluding energy from alcohol).

Table 8. Energy and ‘sugars’ intake for male children and adolescents ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	SD	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference
Australia	1995	Total sugars	2–3	170	6.6	124		30.3	National Nutrition Survey	24 h dietary recall	31
	2007	Total sugars	2–3	550	6.2	102		26.1	Australian National Children’s Nutrition and Physical Activity Survey	24 h dietary recall	59
	2011–2012	Total sugars	2–3		6.0	94	4.4†	24.9	Australian Health Survey	24 h dietary recall	32
	2007	Total sugars	4–8	613	6.2	117		24.3	Australian National Children’s Nutrition and Physical Activity Survey	24 h dietary recall	59
	2011–2012	Total sugars	4–8		7.6	111	3.1†	23.3	Australian Health Survey	24 h dietary recall	32
	2007	Total sugars	9–13	525	7.6	146		23.6	Australian National Children’s Nutrition and Physical Activity Survey	24 h dietary recall	59
Denmark	2011–2012	Total sugars	9–13		9.2	125	4.1†	21.7	Australian Health Survey	24 h dietary recall	32
	1995	Added sugars	4–14	484	9.6	77		14‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2000–2002	Added sugars	4–14	428	9.3	72		13‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	2003–2006	Added sugars	4–14	329	8.9	61		11‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
Germany	1985–1989	Sucrose	15–18	385		48§			NVS	7 d dietary record	48
	2005–2007	Sucrose	15–19	506		62§			NVS II	24 h recall	
The Netherlands	1987–1988	Mono- and disaccharides	1–4	163	6.0	116	39	32.8	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	1–4	149	5.4	106	32	33.4	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	1–4	135	6.1	118	35	33.2	VCP-3	2 d dietary record	27
	1987–1988	Mono- and disaccharides	4–7	128	7.5	135	42	30.5	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	4–7	164	7.3	131	32	30.9	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	4–7	138	6.9	132	37	32.1	VCP-3	2 d dietary record	27
	1987–1988	Mono- and disaccharides	7–10	120	8.4	136	38	27.3	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	7–10	127	8.4	140	44	27.8	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	7–10	104	8.4	147	43	29.6	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	7–10	231	8.5	145	44	29.0	VCP 2007–2010	2 × 24 h recall	28
	1987–1988	Mono- and disaccharides	10–13	148	9.7	146	43	25.8	VCP-1	2 d dietary record	27
	1992	Mono- and disaccharides	10–13	136	9.4	149	55	26.8	VCP-2	2 d dietary record	27
	1998	Mono- and disaccharides	10–13	112	9.4	150	41	27.4	VCP-3	2 d dietary record	27
	2007–2010	Mono- and disaccharides	10–13	202	9.5	154	51	27.4.0	VCP 2007–2010	2 × 24 h recall	28
	UK	1987–1988	Mono- and disaccharides	13–16	156	11.4	169	56	25.0	VCP-1	2 d dietary record
1992		Mono- and disaccharides	13–16	119	10.7	168	61	26.5	VCP-2	2 d dietary record	27
1998		Mono- and disaccharides	13–16	137	10.9	174	52	27.0	VCP-3	2 d dietary record	27
2007–2010		Mono- and disaccharides	13–16	215	10.9	169	62	26.3	VCP 2007–2010	2 × 24 h recall	28
1997		Total sugars	4–10	440	7.1	110	37	24.5‡	NDNS	7 d dietary record	56
2008–2009/2011–2012		Total sugars	4–10	665	6.6	100	33	23.8‡	NDNS	4 d dietary record	57
1997		Total sugars	11–18	416	9.0	126	54	22.1‡	NDNS	7 d dietary record	56
2008–2009/2011–2012		Total sugars	11–18	744	8.3	116	48	22.0‡	NDNS	4 d dietary record	57
1997		NMES	4–10	440	7.1	77	32	17.2‡	NDNS	7 d dietary record	56
2008–2009/2011–2012		NMES	4–10	665	6.6	63	29	14.8‡	NDNS	4 d dietary record	57
1997		NMES	11–18	416	9.0	94	47	16.4‡	NDNS	7 d dietary record	56
2008–2009/2011–2012		NMES	11–18	744	8.3	84	43	16.0‡	NDNS	4 d dietary record	57

NVS, German National Food Consumption Survey; VCP, Voedselconsumptiepeilingen; NDNS, National Diet and Nutrition Survey; NMES, non-milk extrinsic sugars.

† Relative standard error of estimate (%).

‡ Percentage food energy (excluding energy from alcohol).

§ Median value.

|| Reanalysed to provide estimates for 4 d to allow comparison with later surveys.

Table 9. Energy and 'sugars' intake for female children and adolescents ordered by country

Country	Survey year	Sugar(s) categorisation	Age range (years)	Subjects (n)	Energy (MJ/d)	Mean sugar(s) (g/d)	SD	% Energy from sugar(s) category	Name of survey	Method of dietary analysis	Reference	
Australia	1995	Total sugars	2–3	213	6.1	107		28.4	National Nutrition Survey	24 h dietary recall	31	
		Total sugars	2–3	521	5.9	96		25.6	Australian National Children's Nutrition and Physical Activity Survey	24 h dietary recall	59	
	2011–2012	Total sugars	2–3		5.9	89	3.8†	24.1	Australian Health Survey	24 h dietary recall	32	
		Total sugars	4–8	603	6.9	106		24.3	Australian National Children's Nutrition and Physical Activity Survey	24 h dietary recall	59	
	2011–2012	Total sugars	4–8		6.4	95	2.9†	23.8	Australian Health Survey	24 h dietary recall	32	
		Total sugars	9–13	585	8.2	124		23.9	Australian National Children's Nutrition and Physical Activity Survey	24 h dietary recall	59	
	Denmark	2011–2012	Total sugars	9–13		8.0	115	2.5†	23.5	Australian Health Survey	24 h dietary recall	32
			Added sugar	4–14	500	8.6	70		14‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
		2000–2002	Added sugar	4–14	395	8.1	64		13‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34
	Added sugar		4–14	340	7.7	56		12‡	Danish Survey of Dietary Habits and Physical Activity	7 d dietary record	34	
Germany	1985–1989	Sucrose	15–18	519		53§			NVS	7 d dietary record	48	
The Netherlands	2005–2007	Sucrose	15–19	506		52§			NVS II	24 h recall		
		Mono- and disaccharides	1–4	140	5.6	109	39	32.9	VCP-1	2 d dietary record	27	
	1992	Mono- and disaccharides	1–4	202	5.5	106	35	33.1	VCP-2	2 d dietary record	27	
		Mono- and disaccharides	1–4	119	5.4	107	37	33.4	VCP-3	2 d dietary record	27	
	1987–1988	Mono- and disaccharides	4–7	128	6.7	119	35	30.4	VCP-1	2 d dietary record	27	
		Mono- and disaccharides	4–7	165	6.6	120	32	31.1	VCP-2	2 d dietary record	27	
	1998	Mono- and disaccharides	4–7	138	6.6	128	33	33.2	VCP-3	2 d dietary record	27	
		Mono- and disaccharides	7–10	133	7.9	132	36	28.4	VCP-1	2 d dietary record	27	
	1992	Mono- and disaccharides	7–10	127	7.6	129	35	28.9	VCP-2	2 d dietary record	27	
		Mono- and disaccharides	7–10	134	7.6	132	37	29.5	VCP-3	2 d dietary record	27	
	2007–2010	Mono- and disaccharides	7–10	216	8.0	139	39	29.4	VCP 2007–2010	2 × 24 h recall	28	
		Mono- and disaccharides	10–13	138	9.2	141	47	25.8	VCP-1	2 d dietary record	27	
	1992	Mono- and disaccharides	10–13	119	8.7	137	39	26.7	VCP-2	2 d dietary record	27	
		Mono- and disaccharides	10–13	124	8.6	145	42	28.5	VCP-3	2 d dietary record	27	
	2007–2010	Mono- and disaccharides	10–13	211	8.7	142	43	27.6	VCP 2007–2010	2 × 24 h recall	28	
		Mono- and disaccharides	13–16	149	9.7	145	51	25.5	VCP-1	2 d dietary record	27	
	1992	Mono- and disaccharides	13–16	133	9.1	140	48	25.8	VCP-2	2 d dietary record	27	
		Mono- and disaccharides	13–16	117	8.7	137	48	26.4	VCP-3	2 d dietary record	27	
	2007–2010	Mono- and disaccharides	13–16	221	8.5	132	46	26.0	VCP 2007–2010	2 × 24 h recall	28	
		Total sugars	4–10	397	6.3	99	33	24.4‡	NDNS	7 d dietary record	56	
UK	2008–2009/2011–2012	Total sugars	4–10	612	6.3	95	31	23.8‡	NDNS	4 d dietary record	57	
		Total sugars	11–18	448	7.0	97	40	21.9‡	NDNS	7 d dietary record	56	
	2008–2009/2011–2012	Total sugars	11–18	753	6.6	90	38	21.8‡	NDNS	4 d dietary record	57	
		NMES	4–10	397	6.3	69	28	17.1‡	NDNS	7 d dietary record	56	
	2008–2009/2011–2012	NMES	4–10	612	6.3	59	25	14.6‡	NDNS	4 d dietary record	57	
		NMES	11–18	448	7.0	70	35	15.8‡	NDNS	7 d dietary record	56	
	2008–2009/2011–2012	NMES	11–18	753	6.6	64	34	15.2‡	NDNS	4 d dietary record	57	

NVS, German National Food Consumption Survey; VCP, Voedselconsumptiepeilingen; NDNS, National Diet and Nutrition Survey; NMES, non-milk extrinsic sugars.

Mean value was significantly different from previous survey: * $P < 0.05$, ** $P < 0.01$.

† Relative standard error of estimate (%).

‡ Percentage food energy (excluding energy from alcohol).

§ Median value.

|| Reanalysed to provide estimates for 4 d to allow comparison with later surveys.

used FFQ in some surveys. We are unable to comment on the degree to which misreporting may have affected the results of surveys, since only a few reports and papers specifically refer to this source of potential error. For example, analysis of UK data in children and adolescents provided different results for total sugars intake in one age group depending on whether identified over- and under-reporters of energy intake were included in the analysis⁽²⁴⁾. It may be proposed that an increased focus on dietary sugars intake in the scientific and general media could affect self-reporting in some or all population sectors in more recent surveys.

As noted previously⁽³⁾, a variety of terms is employed by countries in estimating dietary sugars intake. Such diversity makes comparisons between countries, or indeed within some countries, difficult. It has previously been suggested that the most useful terminology is total sugars, with further division, where necessary, into mono- and disaccharides⁽²⁵⁾. Very few countries or authors appear to have examined differences or trends in sugars intake^(11,12,14), or the statistical significance of these differences where they were reported. The rudimentary level of our analysis is acknowledged and it is suggested that all comparisons should be viewed with caution. Although some changes may reflect real differences in dietary intake, they may also reflect methodological or demographic differences between surveys. In addition, the analysis only allows some comparison by sex and age group with no further analysis by ethnic groups or socio-economic status.

Summary

Results of national nutrition surveys are important in informing research and public health policy. Multiple national nutrition surveys have been undertaken in a number of developed countries, and reveal that the direction of change of dietary sugars intake can vary by subpopulation. Therefore, references to changes in dietary sugars intake should be made, wherever possible, in relation to specific populations, i.e. by country, sex and age group. Although estimates of mean population dietary sugars intake may be increasing in some specific subpopulations, most comparisons reveal stable or decreasing trends in dietary sugars intake.

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