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ORIGINAL RESEARCH

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Patterns of discretionary food intake among Australian children and their association with socio-demographic, lifestyle, and adiposity measures

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Abstract

Aim: Australian children consume 35% of energy from discretionary food and beverages which increases their risk of non-communicable diseases like type 2 diabetes. Despite this concerning statistic, broad analysis of the profile of discretionary food intake has not been fully undertaken. This study asks: what is the discretionary food and beverage intake profile, contribution to nutrient intakes, and associations with demographic and health characteristics?

Methods: Cross-sectional data from the 2011–12 National Nutrition and Physical Activity Survey ($n = 2812$, 2–18 years) were used to profile discretionary food consumption. Dietary intake was assessed by 24-h recall. General linear models tested the difference in respondent characteristics by age group, sex, and quartiles of discretionary food energy contribution.

Results: Ninety-nine percent of respondents consumed discretionary foods, 74% exceeded the maximum discretionary food recommended serves. Among 10 eating occasions available to select: snack, dinner, lunch and morning tea appeared to contribute 76% of discretionary food energy, with snack and dinner contributing 24% each. Age and frequency of discretionary food consumption were positively associated with energy intake from discretionary foods ($p < 0.001$); while sex, socio-economic status, physical activity and body composition had no association. High discretionary food consumers chose specific discretionary food items in a large quantity (1.0–3.5-serves/discretionary food) compared to low discretionary food consumers (0.4–1.4-serves/discretionary food).

Conclusions: Nearly all Australian children and adolescents consumed discretionary food daily. No demographic or anthropometric characteristics beyond increasing age were associated with higher discretionary food.

Targeted public health policy and community interventions are required to focus on addressing the largest contributors to discretionary food intake in terms of equivalent serve sizes, popularity, and eating occasion.

KEYWORDS
adolescent, children, diet, nutrient intake, population health

1 | INTRODUCTION

Poor diet quality is one of the leading contributors to the rise of non-communicable diseases in children and adolescents globally.[1] In Australia, 400 children and adolescents are diagnosed with type 2 diabetes each year and one in ten have elevated blood pressure.[2,3] Of concern, non-communicable diseases which are prevalent in children adversely affect growth, development, and maturation leading to compromised health in adulthood and reduced life expectancy.[4,5]

The Australian Dietary Guidelines provide recommendations for food and beverage intake to ensure the optimal growth and development of Australians, including children and adolescents.[6] The Australian Dietary Guidelines encourage eating from the five core food groups, where non-core foods and beverages, referred to as discretionary foods and beverages, are not required to provide essential nutrition and are high in saturated fat, added sugars, added salt, or alcohol, and low in dietary fibre.[6] The Australian Dietary Guidelines acknowledge discretionary foods and beverages may contribute to the enjoyment of eating, but should be limited. For children or inactive adolescents the recommended maximum discretionary foods and beverages serves are 0–½-serves/day; and 0–2½-serves/day for highly active boys older than 4 years, girls older than 9 years, and adolescents.[6] A serve of discretionary foods and beverages is defined as contributing 600 kJ; e.g., 2 scoops of ice-cream, one tablespoon of honey or butter, one can of soft-drink, or 12 hot chips. Consumption beyond the recommended maximum discretionary foods and beverages serves not only contributes to excessive energy intake but also displaces core foods and therefore essential nutrients.[7]

Due to complex socio-economic, historical, environmental, and political factors which affect the Australian food supply and culture, in 2011–12 Australian children and adolescents consumed approximately 35% of their energy intake from discretionary foods and beverages.[8–11] Brief health surveys conducted in 2012, 2015, and 2018 revealed a slight increase in the number of children aged 2–18 years meeting recommendations for fruit and vegetables (4.8, 5.1 and 6.0% respectively), but the numbers remained low. Similarly, only a minimal drop in the proportion of children consuming sugar-sweetened drinks (2.2% decrease) was observed.[12] Despite these concerning statistics, a broad analysis of discretionary foods and beverages intake profile of Australian children and adolescents has not been undertaken. A deeper understanding of discretionary foods and beverages intakes and their associations with sociodemographics and non-communicable disease risk factors may provide an opportunity for more relevant and targeted public health policy and community- or school-level interventions, as well as opportunities to intervene at the individual level.

In the latest nationally-representative sample of Australian children and adolescents diets (2011–2012), this study asks: what are the discretionary foods and beverages intake profile, contribution to nutrient intakes, and associations with sociodemographic and health characteristics? While an analysis of children and adolescents' discretionary food intake using national-level data has been previously reported,[13] the current study expands on the earlier findings by reporting the contribution of eating occasions to discretionary foods and beverages consumption and comparing results with the Australian recommendations. Further, associations between discretionary foods and beverages consumption with sociodemographic and health characteristics are examined.

2 | METHODS

This cross-sectional study has been reported according to the Strengthening the Reporting of Observational Studies in Epidemiology checklist for cross-sectional studies.[14] Data were collected under the Census and Statistics Act 1905; thus, ethical approval was not required.

The 2011–12 National Nutrition and Physical Activity Survey was conducted by the Australian Bureau of Statistics on a nationally-representative sample of 12 153 Australians aged 2 years and over.[15] Trained interviewers used the Automated Multiple-Pass Method to capture all foods and beverages consumed by respondents (either the children/adolescents or their primary caregiver) within the 24-hours prior to the interview day. The majority of recalls (84%) were collected from primary caregivers depending on child's age. Children aged

15–17 years were interviewed directly. Total energy and nutrient intakes were derived from the Food Standards Australia New Zealand customised nutrient composition database (AUSNUT).[16] Data from the first 24-h recall among 2812 respondents aged 2–18 years were utilised.

The Australian Bureau of Statistics categorised food groups in the survey as discretionary foods and beverages or non- discretionary foods and beverages based on Australian Dietary Guidelines' definitions.[6] Foods were primarily classified at the minor food group level (5-digit), and where it was not possible to determine if it was discretionary at this level, the unique food code level (8-digit) was used along with the nutrient profiling cut-offs used in the Australian Dietary Guidelines modelling document.[17] Discretionary food and beverage groups in this study were reported at the sub-major food group level (3-digit). There were a total of 132 sub-major food groups in the AUSNUT database, and 60 of these food groups contained a discretionary foods and beverages (hereon in described as discretionary foods and beverages group). The sub-group name is used to refer to foods in those food groups that are discretionary. For example, 'potatoes' only refers to discretionary potatoes, e.g., hot chips.

For the top 20 discretionary foods and beverages groups, the prevalence, mean serves, and mean grams consumed among consumers of the food group (99% of respondents), percent contribution of the food group to total discretionary foods and beverages energy, and the per capita percent contribution of each discretionary foods and beverages group to total sugars (naturally occurring sugars and added sugars combined), saturated fat, and sodium were calculated. Mean daily energy intake, energy intake from discretionary foods and beverages, the proportion of total energy intake from discretionary foods and beverages, and the mean serves of discretionary foods and beverages per day (1-serve = 600 kJ) were calculated. The proportion of energy intake from discretionary foods and beverages was calculated by using total daily energy intake. The quartiles of the percent energy contribution from discretionary foods and beverages were calculated and used to define low consumers as quartile one and high consumers as quartile four.

As part of the survey, respondents were asked to identify the name of their reported eating occasion as well as the time they began consuming each food or beverage. The available eating occasion options in the survey were: breakfast, morning tea, brunch, lunch, afternoon tea, dinner, supper, snack, beverage/drink, extended consumption, or other, and were chosen by participants, and were irrespective of time of day. An eating occasion was further defined as the consumption of one or more foods or beverages at the same time. The proportion of eating occasions at which a discretionary foods and beverages was consumed and the percent contribution of each eating occasion to total discretionary foods and beverages energy were calculated. Among the top four eating occasions that contributed the most to daily discretionary foods and beverages energy, the top five sub-major food groups, the percent of total discretionary foods and beverages energy that it contributed at the eating occasion, and the mean energy intake among consumers of the food group were calculated.

Respondents were classified by age group (2–3, 4–8, 9–13, and 14–18 years), sex, socio-economic status, physical activity level, adiposity measures, and usual fruit and vegetable serves. The Socio-Economic Indexes for Areas (SEIFA),[18] that ranks areas in Australia into quintiles according to relative socio-economic advantage or disadvantage using postcode, was used to define socio-economic status. Physical activity was the amount of physical activity each respondent reported that they undertook in the week prior to the survey. For children aged 2-4-years, physical activity included any active play or movement such as free play in a playground or tidying up. The total number of minutes of physical activity was recorded, with one session equivalent to 30-minutes of moderate-intensity physical activity. The amount of time spent sitting or lying down for school, transport, and leisure during the week prior to the survey was also self-reported by respondents. Respondents were classified based on the duration and number of sessions of physical activity into three categories: inactive, insufficiently active, or sufficiently active for health.[19]

Physical measurements including weight, height, and waist circumference were measured for all respondents by trained interviewers. Body mass index (BMI) z-score, also known as BMI standard deviation (SD) score, is a measure of relative weight adjusted for age and sex. The BMI z-score was calculated using the respondents' age, sex, height, and weight; and the World Health Organization growth reference standards for 2–4 and 5–19-year-old children.[20] The standard normal distribution was then calculated for all respondents' BMI z- scores. This was used to categorise children into three BMI percentile categories: <85% (recommended BMI), ≥85% to <95%, or ≥95%. Each respondent's waist circumference to height ratio was calculated and categorised as <0.5 (recommended ratio) or ≥0.5, reflecting cardiometabolic risk.[21] Respondents were asked to specify the usual number of fruit and vegetable serves consumed per day from the following options: do not eat fruit/vegetables, ≤1-serve, 1-serve, 2-serves, 3-serves, 4-serves, 5-serves, or ≥6-serves. To determine the mean number of serves, 'don't eat fruit/vegetables' was defined as 0, '≤1 serve' as 0.5, and '≥ 6-serves' as 6.

This study used energy intake (EI) to basal metabolic rate (BMR) ratio (EI:BMR) to calculate under-reporters as respondents with implausibly low intakes. Respondents were classified as under-reporters or not under-reporters based on the Goldberg[22] cut-off limit of 0.9 for EI:BMR, which is the lower 95% confidence limit for a single day of data for a single individual, allowing for day-to-day variation in energy intakes, and errors in calculation of EI:BMR.

The statistical package IBM SPSS, version 23.0[23] (IBM Corp.,) was used for all analyses. Due to the large sample size and the number of tests, p-values <0.001 were treated as significant. The data were weighted using proportional weights so that the sum of the weights was the same as the overall sample size; all results presented in this paper are based on weighted analyses. Descriptive summaries were calculated for all variables of interest. General linear models were used to investigate the difference in respondent characteristics by age group, sex, and quartiles of discretionary foods and beverages energy contribution, and post hoc pairwise comparisons using the Bonferroni correction were performed to show pairwise significance between quartiles of discretionary foods and beverages energy contribution. The main effects of the factors were included, together with the interaction of age and sex. To compare group differences for categorical variables, the Pearson chi-square test was carried out.

3 | RESULTS

Almost all of the 2812 children and adolescents consumed discretionary foods and beverages on the day of the survey (99%) and 74% of the respondents exceeded the discretionary foods and beverages serve recommendations (Table 1). Between 70% and 80% of all sex and age groups exceeded the serving recommendation, except for the sex and age group females 4-8-years (88%) and males 14–18-years (54%). The mean intake was 5.1 discretionary foods and beverages serves per day. For all respondents aged ≥4-years, males had a higher discretionary foods and beverages intake and a higher proportion of energy from discretionary foods and beverages for several age groups; however, more females exceeded discretionary foods and beverages serves across all age groups than males (Table 1).

More than a third of daily energy intake came from discretionary foods and beverages for all age and sex groups with the exception of children aged 2-3-years, where it was just under 30% (27.6 ± 1.4% for males, 29.5% ± 1.6% for females). For each age group, the number of total eating occasions and the proportion of eating occasions at which a discretionary foods and beverages was consumed were similar between males and females. Overall, more than half of all eating occasions contained discretionary foods and beverages (55.6 ± 0.4%).

Among discretionary foods and beverages consumers, the top five discretionary foods and beverages food groups ranked by their contribution to daily discretionary foods and beverages energy intake were: cakes, muffins, scones, cake-type desserts (9.4%); sweet biscuits (7.2%); pastries (6.6%); potatoes (6.2%); and frozen milk products (5.8%). The lowest ranked were butters (1.5%); fish and seafood products (1.6%), and other confectionary (1.8%) (Table S1, supplementary material). Three discretionary foods and beverages food groups (mixed dishes where cereal is the major ingredient e.g. pizzas, burgers, sushi; cakes, muffins, scones, cake-type desserts; and pastries) were consumed in large quantities (3.5, 3.0 and 2.6 discretionary foods and beverages serves, respectively) but were not among the top five food groups when ranked by popularity. In contrast, sweet biscuits and frozen milk products were consumed in relatively small quantities (1.1 and 1.4 discretionary foods and beverages serves, respectively) but were both among the five most popular discretionary foods and beverages food groups.

The top five food groups ranked by popularity (sweet biscuits; soft-drinks, and flavoured mineral waters; sugar, honey and syrups; processed meat; frozen milk products) had between 20.5% and 31.0% consumers, with a mean quantity of around ≤1-serves per consumer (Table S1, supplementary material). Of the top 20 discretionary food groups; soft-drinks and flavoured mineral waters contributed the most to free sugars; sweet biscuits the most to saturated fat; and processed meat the most to sodium (Table S1, supplementary material).

The top four eating occasions by contribution to total discretionary energy were: snack, dinner, lunch, and morning tea; together they contributed 76% of discretionary foods and beverages energy with snack and dinner contributing 24% each (Table 2). The top food groups at snack, dinner, lunch, and morning tea were: chocolate and chocolate-based confectionary (14%), potatoes (12%), pastries (13%), and cakes, muffins, scones, cake-type desserts (21%), respectively.

As well as being the top contributor to morning tea discretionary foods and beverages intake, cakes, muffins, scones, cake-type desserts was among the top five contributors to snack (3rd) and to lunch (5th). Other food groups that were top discretionary foods and beverages contributors in two different eating occasions were sweet biscuits (2nd-highest contributor to snack and morning tea), potatoes (highest contributor to dinner and 2nd-highest to lunch), mixed dishes where cereal is the major

TABLE 1 Discretionary food and beverage intake characteristics of 2812 children and adolescents 2–18 years from the 2011–12 National Nutrition and Physical Activity Survey

	2–3 y				4–8 y				9–11 y				12–13 y				14–18 y				All respondents 2–18 y	
	M		F		M		F		M		F		M		F		M		F			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Exceeded DF servings[a]	135	78.0	125	79.1	306	73.2	343	87.9	194	75.5	201	79.1	145	73.2	141	73.4	208	53.5	281	73.4	2079	73.9
Prevalence of consumers by DF servings																						
Non-consumers	5	2.9	5	3.0	1	0.3	7	1.8	1	0.4	0	0.0	4	2.0	5	2.6	4	1.1	8	2.0	40	1.4
>0–1[b]	33	19.4	29	18.4	39	9.3	43	10.9	14	5.4	13	5.1	11	5.6	12	6.2	22	5.8	34	8.9	249	8.9
>1–3	61	35.1	70	44.2	102	24.3	119	30.5	50	19.5	40	15.8	38	19.2	48	24.9	69	17.8	85	22.3	682	24.3
>3–5	45	26.0	21	13.4	115	27.5	119	30.6	74	28.8	70	27.7	37	18.7	54	28.0	86	22.2	88	23.0	710	25.3
>5	29	16.5	33	20.9	162	38.7	102	26.2	118	45.9	130	51.4	108	54.5	74	38.3	207	53.2	167	43.7	1130	40.2
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
DF servings	2.9	0.2	3.1	0.2	4.9	0.2	3.9	0.1	5.7	0.2	5.6	0.2	6.2	0.3	5.0	0.3	6.9	0.3	5.5	0.2	5.1	0.1
Energy intake (MJ)	6.0	0.2	5.9	0.2	7.6	0.1	6.4	0.1	8.9	0.2	8.1	0.2	9.6	0.3	7.8	0.2	10.2	0.2	8.1	0.2	8.0	0.1
Energy from DF (%)	27.6	1.4	29.5	1.6	37.3	1.0	34.8	0.9	37.9	1.3	40.0	1.2	37.8	1.4	37.6	1.5	38.8	1.1	38.1	1.1	36.6	0.4
EO	7.5	0.2	7.8	0.2	7.1	0.1	7.1	0.1	7.3	0.1	7.1	0.1	6.8	0.1	6.8	0.2	6.2	0.1	6.2	0.1	6.9	0.0
EO with DF	3.4	0.1	3.3	0.1	3.9	0.1	3.8	0.1	4.3	0.1	4.2	0.1	3.9	0.1	3.6	0.1	3.6	0.1	3.4	0.1	3.8	0.0
EO with DF (%)	46.5	1.6	44.3	1.7	55.5	1.0	55.3	1.1	58.6	1.1	59.3	1.1	57.9	1.5	54.1	1.6	59.0	1.1	56.3	1.1	55.6	0.4

Abbreviations: DF, discretionary foods and beverages; EO, eating occasion; F, females; M, males; MJ, mega joules; SE, standard error; y, years.

[a]Maximum recommended DF serves: 2–3y boys 1 serving, 2–3y girls 1 serving, 4–8y boys 2.5 servings, 4–8y girls 1 servings, 9-11y boys 3 servings, 9-11y girls 3 servings, 12-13y boys 3 servings, 12-13y girls 2.5 servings, 14–18y boys 5 servings, 14–18y girls 2.5 servings.

[b]Includes those who consumed discretionary foods or beverages that do not contain energy, such as diet or zero calorie soft drinks.

TABLE 2 Top four reported eating occasions[a] that contributed the most to total discretionary food and beverage energy intake and the top five sub-major food groups by per cent contribution to discretionary energy at each reported eating occasion among 2812 children and adolescents aged 2–18 years from the 2011–12 National Nutrition and Physical Activity Survey

	Snack 23.9% of total DF energy			Dinner 23.8% of total DF energy			Lunch 19.6% of total DF energy			Morning tea 8.8% of total DF energy		
Rank	Sub-major food group[b]	Contribution to total DF energy at the EO (%)	kJ among consumers of the food group (mean)	Sub-major food group	Contribution to total DF energy at the EO (%)	kJ among consumers of the food group (mean)	Top sub-major food group	Contribution to total DF energy at the EO (%)	kJ among consumers of the food group (mean)	Sub-major food group	Contribution to total DF energy at the EO (%)	kJ among consumers of the food group (mean)
1	Chocolate and chocolate-based confectionery	13.9%	811	Potatoes	12.2%	868	Pastries	13.3%	1475	Cakes, muffins, scones, cake-type desserts	20.5%	1651
2	Sweet biscuits	12.9%	600	Sausages, Frankfurts and saveloys	11.6%	1373	Potatoes	10.6%	1123	Sweet biscuits	18.1%	564
3	Cakes, muffins, scones, cake-type desserts	12.2%	1648	Mixed dishes where cereal is the major ingredient[c]	11.0%	2350	Mixed dishes where cereal is the major ingredient	7.4%	2025	Muesli or cereal style bars	13.0%	532
4	Frozen milk products	10.5%	786	Pastries	9.8%	1442	Cakes, muffins, scones, cake-type desserts	7.4%	1690	Potato snacks	8.4%	608
5	Potato snacks	8.1%	744	Frozen milk products	8.7%	787	Processed meat	6.7%	220	Savoury biscuits	7.6%	770

Abbreviations: DF, discretionary foods and beverages; EO, eating occasion.

[a]The remaining 23.8% of DF consumption came from breakfast 7.4%, brunch 0.5%, afternoon tea 7.4%, supper 2.0%, beverage/drink 4.5%, extended consumption 1.7%, and other 0.3%.

[b]The sub-group name is used to refer to foods in those food groups that are discretionary. For example, 'potatoes' only refers to discretionary potatoes, e.g., hot chips.

[c]Includes foods such as sandwiches, burgers, wraps, sushi, pizzas.

ingredient (3rd-highest contributor to dinner and lunch), and pastries (4th-highest contributor to dinner and highest contributor to lunch) (Table 2).

The contribution of discretionary foods and beverages to total daily energy in quartile 1 (low consumers) ranged between 0–21% and between 50–100% in quartile 4 (high consumers) (Table 3). High consumers of discretionary foods and beverages were older; 6.7% of those aged 2–3-years were high consumers compared to 66.2% of those aged 9–18-years ($p < 0.001$). There were no significant differences between sex, socio-economic status, physical activity, BMI z-score, or waist-to-height ratio groups and quartiles of energy intake from discretionary foods and beverages. There was also no significant association between prevalence of under-reporting and quartile of discretionary foods and beverages intake.

Based on general linear models adjusted for age, sex, and their interaction, total daily energy and discretionary foods and beverages energy intake increased with increasing quartile of discretionary foods and beverages intake ($p < 0.001$) (Table 4). The number of daily eating occasions did not differ by quartile of discretionary foods and beverages intake, but high discretionary foods and beverages consumers had almost double the number of eating occasions that contained discretionary foods and beverages compared to low consumers ($p < 0.001$). Similarly, the proportion of eating occasions at which discretionary foods and beverages was consumed increased from 37.4% among low consumers to 66.9% among high consumers ($p < 0.001$).

Self-reported usual daily fruit serves were higher among low (2.2 ± 0.0 serves) compared to high (1.8 ± 0.0 serves) discretionary foods and beverages consumers ($p < 0.001$) but were not significantly different to consumption by children from quartile 2 or quartile 3. Self-reported usual daily vegetable serves were higher among low consumers (2.1 ± 0.0 serves) compared to children in all other quartiles (1.8 ± 0.0 serves) ($p < 0.001$).

All but one food group in the top five discretionary foods and beverages groups ranked by their contribution to discretionary foods and beverages energy among low consumers were different to those among high consumers (Table 5). Soft-drinks and flavoured mineral waters was the second-top contributor among low consumers and fifth-top among high consumers. The top five discretionary foods and beverages groups among low consumers were all among the top five most popular discretionary foods and beverages groups among all children, and were consumed in smaller quantity (≤2-serves), whereas the top five discretionary foods and beverages groups among high consumers were not as popular (apart from soft-drinks and flavoured mineral waters) but were characterised by larger quantities (mostly >2-serves) (Table 2).

4 | DISCUSSION

The results of this study demonstrate that nearly all Australian children and adolescents consumed discretionary foods and beverages, with 70%–80% of respondents exceeding national recommendations for discretionary foods and beverages intake.[24] Sweet biscuits, cake and cake-like desserts, potatoes, frozen milk products, and soft-drinks and flavoured mineral waters may have the largest public health impact on Australian children and adolescents as they were both the most frequently consumed discretionary foods and beverages and contributed the most to energy intake. The type of discretionary foods and beverages consumed differed by type of eating occasion with savoury discretionary foods and beverages groups such as potatoes, processed meats, and pastries the largest contributors at lunch and dinner; and sweet discretionary foods and beverages food groups such as chocolate, cake and cake-like desserts, and sweet biscuits the largest contributors to morning tea and snack. However, although discretionary foods and beverages consumed during meals and mid-meals may differ in their characteristics, this study found all eating occasions are contributors to discretionary foods and beverages intake in Australian children and adolescents.

This study found that the discretionary foods and beverages intake of Australian children and adolescents had similarities with the discretionary foods and beverages intake of Australian adults, where cake and cake-like desserts were the largest contributor to discretionary foods and beverages energy intake to both groups; and pastries, soft-drinks and flavoured mineral waters, and sweet biscuits all in the top five contributors if alcohol was excluded.[25] However, unlike Australian adults, with whom higher discretionary foods and beverages intake was associated with lower socio-economic status and higher waist circumference,[25] no demographic nor anthropometric characteristics beyond increasing age were associated with higher discretionary foods and beverages intake in Australian children and adolescents. Although females and males had similar discretionary foods and beverages intake, more females than males exceeded the recommended maximum discretionary foods and beverages serves, as females have a lower maximum discretionary foods and beverages serves target. Any intervention which aims to address this phenomenon in females should be carefully designed so as not to promote disordered eating habits.[26]

Whilst the most consumed discretionary foods and beverages foods (sweet biscuits; soft-drinks and flavoured mineral waters; sugar, honey, and syrups; frozen milk products; and chocolate and chocolate-based confectionary) are relevant for public health initiatives; they do not necessarily have the largest public health impact due to

TABLE 3 Associations between quartiles of energy contribution from discretionary foods and beverages and demographic and adiposity-related measures and lifestyle characteristics among 2812 children and adolescents 2–18 years from the 2011–12 National Nutrition and Physical Activity Survey

Characteristic	Q1 (low consumer)	Q2	Q3	Q4 (high consumer)	*p* value from Pearson's chi-square test
Range of % energy from DF	0–21.4	21.4–35.5	35.5–50.4	50.4–100	
	%	%	%	%	
Sex (within quartile)					0.278
Female	48.1	48.1	52.1	47.4	
Male	51.9	51.9	47.9	52.6	
Age groups (within quartile)					< 0.001
2–3 y	19.2	12.0	9.2	6.7	
4–8 y	27.8	29.9	30.2	27.1	
9–11 y	14.5	17.9	19.9	20.3	
12–13 y	12.4	13.2	14.7	15.1	
14–18 y	26.1	26.9	26.0	30.8	
Age and sex groups (within quartile)					
Females					< 0.001
2–3 y	18.9	11.2	8.4	7.8	
4–8 y	29.5	29.3	30.5	23.9	
9–11 y	12.1	17.8	21.3	22.4	
12–13 y	13.9	12.1	13.4	16.4	
14–18 y	25.7	29.6	26.4	29.6	
Males					< 0.001
2–3 y	19.5	12.4	10.1	5.7	
4–8 y	26.3	30.8	29.8	30.1	
9–11 y	16.7	17.9	18.5	18.4	
12–13 y	11.0	14.6	16.1	13.8	
14–18 y	26.6	24.5	25.6	32.0	
Quintiles SEIFA[a] (within quartile)					0.020
Lowest 20%	25.0	23.2	27.5	24.4	
Highest 20%	24.5	24.4	29.2	21.9	
Met physical activity guidelines[e] (within quartile)					
2–4 y	71.3	79.2	76.8	80.9	0.273
5–17 y	18.6	20.6	18.7	19.8	0.824
18 y	54.8	26.4	30.7	41.3	0.002
zBMI group[b] (within quartile)					0.032
<85%	66.2	68.1	67.8	71.8	
≥ 85% to <95%,	11.9	13.2	15.8	10.4	
≥ 95%	22.0	18.8	16.4	17.9	

TABLE 3 (Continued)

Characteristic	Q1 (low consumer)	Q2	Q3	Q4 (high consumer)	*p* value from Pearson's chi-square test
Waist: height ratio group[c] (within quartile)					0.004
No risk of chronic disease	63.8	66.0	69.9	73.1	
Increased risk of chronic disease	36.2	34.0	30.1	26.9	
Under-reporters[d] (within quartile)	24.9	17.6	13.6	14.1	0.001

Abbreviations: Q, quartile; DF, discretionary foods and beverages; y, years; SEIFA, Socio-Economic Indexes for Areas; zBMI, body mass index-for-age-z-score; EO, eating occasion.
[a]SEIFA was developed by the ABS and ranks areas in Australia according to their relative socio-economic advantage (20).
[b]Calculated using the standard normal distribution of BMI z-scores: < 85%, ≥ 85% to <95%, and (≥ 95%) (22).
[c]In children a waist circumference to height ratio of <0.5 is associated with a low risk of chronic disease, whereas a ratio of >0.5 is associated with a higher risk (23). Therefore, a waist circumference to height ratio of 0.5 was used as a cut-off for waist circumference and risk of metabolic complications.
[d]Among children aged 10 years and over. Participants were classified as under-reporters based on the Goldberg cut-off limit of an energy intake to basal metabolic rate ratio of 0.9 (24).
[e]For children 2–4 years old at least three hours of physical activity every day is recommended; for children 5–17 years old at least 60 minutes of moderate to vigorous physical activity every day is recommended; for 18-year-olds at least 150 minutes of physical activity over five or more sessions per week is recommended (17).

TABLE 4 The estimated effect of quartiles of energy contribution from discretionary foods and beverages on diet, lifestyle, and adiposity-related characteristics among 2812 children and adolescents 2–18 years from the 2011–12 National Nutrition and Physical Activity Survey

	Q1 (low consumer)		Q2		Q3		Q4 (high consumer)		
Characteristic[a]	Mean	SE	Mean	SE	Mean	SE	Mean	SE	*P* value[b]
Energy intake (MJ)[f]	6.8[g]	0.1	7.4[g]	0.1	8.1[h]	0.1	8.4[h]	0.1	< 0.001
Discretionary energy intake (MJ)[d]	0.8[g]	0.1	2.1[h]	0.1	3.5[i]	0.1	5.5[j]	0.1	< 0.001
Non-discretionary energy intake (MJ)[f]	6.0[g]	0.1	5.4[h]	0.1	4.6[i]	0.1	2.9[j]	0.1	< 0.001
Proportion of energy from discretionary (%)[c]	11.8[g]	0.3	28.1[h]	0.3	42.6[i]	0.3	63.2[j]	0.3	< 0.001
DF serves[d]	1.4[g]	0.1	3.5[h]	0.1	5.9[i]	0.1	9.2[j]	0.1	< 0.001
Total EO[c]	6.7	0.1	7.1	0.1	7.0	0.1	7.1	0.1	0.001
EO with DF[c]	2.4[g]	0.1	3.7[h]	0.1	4.1[i]	0.1	4.6[j]	0.1	< 0.001
Proportion of EO with DF (%)[c]	37.4[g]	0.7	53.7[h]	0.7	60.1[i]	0.7	66.9[j]	0.7	< 0.001
zBMI[c]	0.70	0.05	0.64	0.05	0.67	0.05	0.54	0.05	0.151
Waist: height ratio[c]	0.49	0.00	0.49	0.00	0.49	0.00	0.49	0.00	0.037
Self-reported fruit serves[c]	2.2[g]	0.0	2.0[g,h]	0.0	2.0[g,h,c]	0.0	1.8[i]	0.0	< 0.001
Self-reported vegetable serves[e]	2.1[g]	0.0	1.8[h]	0.0	1.8[h]	0.0	1.8[h]	0.0	< 0.001

Abbreviations: Q, quartile; SE, standard error; DF, discretionary foods and beverages; EO, eating occasion; zBMI, body mass index-for-age-z-score.
[a]Adjusted for quartile of per cent energy from DF, age group, sex, and their interaction using univariate ANOVA.
[b]*p* values denote the effect of quartiles of per cent energy from DF.
[c]Age group was significant ($p < 0.001$, univariate ANOVA).
[d]Age group and sex were significant ($p < 0.001$) but not their interaction (univariate ANOVA).
[e]Age group and the interaction was age group and sex were significant ($p < 0.001$) but not sex (univariate ANOVA).
[f]Age group, sex, and their interaction were all significant ($p < 0.001$, univariate ANOVA).
[g,h,i,j]Different superscripts denotes significant difference ($p < 0.001$ post hoc, Bonferroni).

variations in average serve sizes. For example, although sweet biscuits were the most highly consumed discretionary foods and beverages, the average serves size was 1.1. Although cake and cake-like desserts and mixed dishes where cereal is the major ingredient were not as commonly consumed; when they were consumed, the average

TABLE 5 The top five sub-major food groups by quartiles of energy contribution from discretionary foods and beverages among children 2–18 years from the 2011–12 National Nutrition and Physical Activity Survey

	Q1 (low consumer)		Q2		Q3		Q4 (high consumer)	
Rank	Sub-major food group[a]	Contribution to total energy intake (%)	Sub-major food group	Contribution to total energy intake (%)	Sub-major food group	Contribution to total energy intake (%)	Sub-major food group	Contribution to total energy intake (%)
1	Sweet biscuits	1.2	Sweet biscuits	2.6	Cakes, muffins, scones, cake-type desserts	4.6	Cakes, muffins, scones, cake-type desserts	6.8
2	Soft drinks, and flavoured mineral waters	0.7	Frozen milk products	1.8	Sweet biscuits	3.2	Pastries	6.0
3	Sugar, honey and syrups	0.6	Cakes, muffins, scones, cake-type desserts	1.5	Frozen milk products	2.8	Potatoes	5.2
4	Frozen milk products	0.6	Soft drinks, and flavoured mineral waters	1.5	Soft drinks, and flavoured mineral waters	2.4	Mixed dishes where cereal is the major ingredient	5.0
5	Chocolate and chocolate-based confectionery	0.6	Potatoes	1.5	Pastries	2.3	Soft drinks, and flavoured mineral waters	3.5

Abbreviation: Q, quartile.

[a]The sub-group name is used to refer to foods in those food groups that are discretionary. For example, 'potatoes' only refers to discretionary potatoes, e.g., hot chips.

serve sizes were 3.0 and 3.5 discretionary foods and beverages serves, respectively. This study found that the top discretionary foods and beverages consumers were those who more commonly chose discretionary foods and beverages foods which had larger average serve sizes, thus contributing to the large 1600 kJ total daily energy intake gap between the lowest and highest discretionary foods and beverages consumers. Soft-drinks and flavoured mineral waters was the only discretionary foods and beverages group which was one of the top discretionary foods and beverages consumed by both low and high consumers, suggesting that although the average serve size was 1.0, this discretionary foods and beverages group may be one of the most important for public health.

The findings of this study also provide a basis for public health policy and interventions to target high discretionary foods and beverages eating occasions, such as snacks, lunch, and dinner, with the provision of core foods such as vegetables.[27,28] Interventions which have shown efficacy at increasing consumption of vegetables and/or decreasing discretionary foods include serving vegetables first at main meals[29]; repeated exposure to vegetables[30]; and for the Australian setting, using a non-institutionalised multidisciplinary and community-based program which increases familiarity with food, cooking, and mindfulness.[31] Substitution of discretionary foods and beverages with foods from the Five Food groups has similarly been suggested by a previous study that examined the contribution of discretionary foods and beverages to the energy, saturated fat and added sugars intakes of Australian children.[13] Further, a study that used a simulation model showed that the substitution of discretionary foods and beverages with foods from the Five Food groups such as fruit and vegetables reduced energy, saturated fat and added sugars intakes.[32] From a policy perspective; research has found that healthy food and drink policies at school significantly improved the food environment for Australian pupils.[33] Although this study found discretionary foods and beverages groups contributed differently to free sugars, saturated fat, and sodium intake; public health and health care providers are moving away from nutrient-focused recommendations and towards those which are food based and address overall diet quality.[34] Introducing health policies at the population level such as regulating marketing tactics and introducing taxes to discretionary foods and beverages have also been suggested based on an ecological framework.[35] Further, a recent study conducted in Australia supports that restricting the merchandising of discretionary foods and beverages is beneficial in reducing discretionary foods and beverages consumption,[36] this, in particular, can be beneficial for children and adolescents as they are susceptible to marketing activity.[37,38]

In Australia, the intake of discretionary foods and beverages decreased from 1995–2007 with a corresponding decrease from 40% to 35% of daily energy intake being derived from discretionary foods and beverages.[39] The current study revealed that this trend has not continued, finding that 36.6% of energy was derived from discretionary foods and beverages in 2011–2012. There is no more recent population-level and nationally representative data for Australia and trends since then are unknown. Although food groups are classified differently, data from the US National Health and Nutrition Examination Survey reported that children and adolescents decreased intakes of solid fats, added sugars, and alcoholic beverages from 1994 to 2010,[40] but trends since then are unknown. Similarly to Australia, intakes of core foods in the USA differed by demographic characteristics but not for the intake of discretionary foods and beverages.[41] This finding suggests that excessive consumption of discretionary foods and beverages is a national public health concern and is not limited to certain population groups.

Qualitative research with Australian children and adolescents has suggested that the maintained excessive intake of discretionary foods and beverages may be partly due to misinterpretation of the Australian Dietary Guidelines. Velardo and Drummond reported that whilst Australian children agreed that discretionary foods and beverages should be consumed only sometimes and in small amounts, they still interpreted this to represent regular intake.[42] Australian children and adolescents may also not recognise discretionary foods and beverages intake; for example children recognised a cream bun as discretionary foods and beverages only if the cream tasted sweet.[42] This suggests that not all of the savoury discretionary foods and beverages intake at lunch and dinner, reported by respondents in this study, may have been recognised as discretionary foods and beverages intake. Such a phenomenon is likely, considering this has been found to occur in Australian adults, where adults mostly recognised discretionary foods and beverages intake when it was consumed between main meals and defined them as snacks.[43] This is also evident in the current findings where respondents selected 'snack' as one of the top two eating occasions where discretionary foods and beverages was consumed. Thus, interventions that increase knowledge, such as educating parents and messages delivered in schools, may have a beneficial impact on children and adolescents' discretionary foods and beverages consumption.[27]

The strength of this study is the use of a large, nationally-representative sample of Australian children and adolescents. Data are limited by being cross-sectional and from a single day of 24-hour recall. Findings do not reflect causal relationships between dietary intake and health, and dietary intakes are not indicative of usual

intakes. Further, despite being the latest available data, data were collected 10 years ago (2011–2012) and may not accurately reflect the current eating patterns of children. Thus, there is a need for a more recent national nutrition survey to investigate the most recent trends in discretionary foods and beverages consumption. Evidence of under reporting of energy intake in the survey was not found to impact results.

Nearly all Australian children and adolescents consumed discretionary foods and beverages daily, across all meals and snacks, with the highest intakes among 4–8-year olds and adolescents at snack, lunch, or dinner. The profile of discretionary foods and beverages intake was characterised by age, average numbers of serves consumed, and frequency of consumption but not body composition, physical activity, socio-economic status, or sex. Broad public health strategies and community- and school-based interventions relevant to the Australian setting are both needed to address the diet quality and health of Australian children and adolescents.

AUTHOR CONTRIBUTIONS

All authors have reviewed and approved the final version of this manuscript prior to submission and declare this work has not been submitted for publication elsewhere. FFM and SM led the drafting of the manuscript. AM conducted the data analysis. All authors contributed to the revision of the manuscript and study concept.

CONFLICT OF INTEREST

FFM, AM, TC, KT, HRA, MB and SM independently work for Nutrition Research Australia, which is funded by government, not-for-profits, community, and industry organisations. FFM, AM, TC, KT, HRA, MB and SM declare no conflicts of interest. The funding body, Nestlé Australia Ltd had no contribution to the analysis plan, the data analysis, drafting of the manuscript, nor interpretation of the findings.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available from the Australian Bureau of Statistics.

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SUPPORTING INFORMATION

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