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Adolescents' beverage choice at school and the impact on sugar intake

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Abbreviations: PLU, Price Look Up; NME sugars, non-milk extrinsic sugars; FSM, Free School Meals

Running title: school beverages

Keywords: adolescents; beverage choice; cluster analysis; school food; juice

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Abstract

OBJECTIVE: To examine students' beverage choice in school, with reference to its contribution to students' intake of non-milk extrinsic (NME) sugars.

SUBJECTS/METHODS: Beverage and food selection data for students aged 11-18 years (n=2461) were collected from two large secondary schools in England, for a continuous period of 145 (School A) and 125 (School B) school days. Descriptive analysis followed by cluster analysis of the beverage data was performed separately for each school.

RESULTS: More than a third of all items selected by students were beverages, and juice-based beverages were students' most popular choice (School A, 38.6%; School B, 35.2%). Mean NME sugars derived from beverages alone was high (School A, 16.7g/student-day; School B, 12.9g/student-day). Based on beverage purchases, six clusters of students were identified at each school, (School A: 'juice-based', 'assorted', 'water'; 'cartoned flavoured milk', 'bottled flavoured milk', 'high volume juice-based'; School B: 'assorted', 'water with juice-based', 'sparkling juice/juice-based', 'water', 'high volume water', 'high volume juice-based'). Both schools included 'high volume juice-based' clusters with the highest NME sugar means from beverages (School A, 28.6g/student-day; School B, 24.4g/student-day), and 'water' clusters with the lowest. A hierarchy in NME sugars was found according to cluster; students in the 'high volume juice-based' cluster returned significantly higher levels of NME sugars than students in other clusters.

CONCLUSIONS: This study reveals the contribution that school beverages combined with students' beverage choice behaviour is making to students' NME sugar intake. These findings inform school food initiatives, and more generally public health policy around adolescents' dietary intake.

Introduction

Levels of childhood obesity in England are alarming; the prevalence of obesity more than doubles from 9.3% to 18.9% as children progress from Reception (age 4-5 years) to Year 6 (age 10-11 years).[1] The picture in secondary schools is similar with more than a third of all 13-15 year olds being overweight (including obese).[2] More than 8 million children in England[3] spend 190 days of the year in school, and so the school environment is not only a good setting to establish and promote healthy food choice behavior and nutrition education strategies, but is also a good source of information on the choices actually being made by the nation's youth. [4]

School food standards in England [5–7] restrict the provision of food and beverages in schools. The standards were reviewed as part of a national School Food Plan[8] and new revised standards[9] became statutory in England in January 2015. The standards stipulate the provision of drinking water, prohibit sugar-sweetened soda beverages and restrict beverages to 'healthier drinks' (Appendix Table 1) such as fruit juice, water, low-fat milk and combination drinks (e.g. fruit/vegetable juice and water, flavoured milk drinks, hot chocolate).[5–7, 10] The implementation of these measures has lead to manufacturers producing or reformulating drinks in order to become school-compliant, e.g. by reducing the sugar content and/or adjusting the fruit juice content.

Nutrient-based standards (effective at the time of the study) also specified maximum levels for fats, sugars and sodium, and minimum requirements for some vitamins and minerals in an average lunch (which took into account beverages as well as food). A key target for these nutrient-based standards was the amount of non-milk extrinsic (NME) sugars[a] (free sugars) which should not exceed 18.9g for an average lunch in a secondary school.[5,6]

This study sought to examine beverages within a school setting, and to explore the relationship between students' beverage choice patterns and the contribution of beverages to students' NME sugar intake.

[a] NME sugars are sugars not bound into the cellular structure of foods (because they have been released from the cellular structure during extraction e.g. sugar found in fruit juice, or because they have been added to a food e.g. table sugar) and excluding lactose in milk and milk products.

Subjects & Methods

Beverage and food choice data for students from two large secondary schools (School A and School B) were collected during the academic year 2010-2011. The schools were in the same Local Authority (unitary authority) in Yorkshire, England and both utilised the Local Authority catering service. The Free School Meal programme in England provides free school meals for students coming from low-income families. Free School Meal (FSM) status, often utilised as a measure of socioeconomic disadvantage in England, was 9% and 17% at School A and B, respectively; the national average was 15.9%.[11]

A selection of beverages, typical of those on offer in English secondary schools, was available at both schools. The set up and arrangement for students to select beverages were similar as both schools utilised the same catering service provider. Catering staff at the till keyed in price look up (PLU) codes (School A, 15 codes; School B, 20 codes) for beverages chosen by students (School A, age 11-16 years; School B, age 11-18 years). Data for a continuous period of 145 and 125 school days for School A and School B, respectively (the difference due to different dates of data acquisition) were captured and analysed.

Statistical Analysis

The data were analysed using IBM SPSS Statistics Version 21. Using descriptive information from the schools' catering managers, as well as manufacturers' data, beverages were categorised into six beverage groups: pure juice (unsweetened 100% fruit juice); juice-based drinks; plain milk; milk-based drinks; hot drinks (hot chocolate, tea, coffee); water. NME sugars (g), energy (kJ, kcal), and volume sizes (ml) were assigned to each PLU code within the dataset. Where one PLU code related to more than one variety of the same drink with slightly different nutrient levels, the most conservative values were used.

Basic descriptive analyses were performed on the datasets to examine the frequency of beverage sales by beverage group. A beverage purchasing profile comprising mean volume (ml/student-day) purchased for each PLU code was then created for each student who bought beverages on more than ten days (School A, *n*=990; School B, *n*=838).

Dietary pattern analysis is an established method of defining a population's dietary behaviour and one approach, cluster analysis, identifies distinct groups of people exhibiting a similar dietary behaviour. Cluster analysis has been successfully applied to characterise dietary patterns in children and young people.[12–17] In this analysis, hierarchical cluster analysis using squared Euclidian distance and Ward's cluster agglomeration was applied to the beverage purchasing profiles, to classify students into mutually exclusive groups based on their beverage choice. Thus, students in clusters were similar to each other but distinctly different from students in other clusters. Clusters were named according to the dominant beverage or beverage group, or where none dominated the cluster was termed 'assorted'. Cluster analysis was performed separately for School A and School B.

For each cluster, the mean beverage volume and the mean NME sugars from beverages purchased per student-day was calculated. Analysis of covariance with adjustment for students' year group and free school meal entitlement was used to ascertain if cluster membership was related to NME sugars contributed from beverages. Two-tailed tests were used and a p-value of less than 0.05 was used to establish statistical significance.

Results

The majority of the student population, at each school utilised the canteen during the study period (School A, 89%; School B, 81%). Of these an overwhelming majority (School A, 97%; School B, 89%) made beverage purchases. Likewise, a large proportion of *these* students, purchased beverages on ten or more days (School A, 81%; School B, 68%).

Students selected a total of 82 497 and 58 479 beverages at School A and School B, respectively; this accounted for more than a third of all food and drink items purchased (School A, 36%; School B, 34%). For both schools, juice-based drinks were the most popular beverages purchased (Figure 1) (School A, 38.6%; School B, 35.2%), followed by milk-based drinks (School A, 27.3%; School B, 20.9%). The overall rank order of popularity for the various beverages purchased was the same across schools, with the exception of water; in School B, water was more popular than pure juice, whilst at School A it was *vice versa*. Water and plain milk were more popular at School B (15.2% and 5.9% of beverage purchases, respectively) than School A (8.0% and 1.0%, respectively). Similarly, hot drinks were more popular at School B (7.8% of beverage purchases) than School A (3.1% of beverage purchases). These differences were statistically significant (Chi-squared=7065.9, df=5, $p<0.001$).

Table 1 describes the specific beverages purchased, alongside energy (kJ, kcal), NME sugar content (g) and volume (ml). School A's most popular beverage was a 330ml beverage (70p), whilst School B's was a 185ml beverage (40p); both were juice-based drinks, available at both schools. Four of the beverages from School A and seven of the beverages from school B exceeded the limit of the current nutrient-based standard for NME sugars of 18.9g for an average lunch. This was reflected in the mean NME sugars derived from beverages *alone* at lunchtime, which was high (School A, 16.7g/student-day; School B, 12.9g/student-day). One out of three beverage purchasers at lunchtime at School A exceeded the NME sugar limit; the equivalent figure for School B was nearly one in four (School A, 34%; School B, 23%).

For students buying beverages, the average daily spend on beverages was 73p and 53p for School A and School B, respectively. The corresponding mean energy and NME sugars derived from beverages were 439kJ (105kcal)/student-day and 18.6g/student-day, respectively (School A), and 381kJ (91kcal)/student-day and 14.8g/student-day, respectively (School B). The average volume purchased was 358ml/student-day and 377ml/student-day at School A and School B, respectively.

Cluster analysis differentiated six mutually exclusive groups of students, defined by the beverage or beverage type. The characteristics of each cluster, including mean beverage volumes and NME sugars from beverages per student-day, are given in Tables 2 & 3; the year group distribution and the proportion of students with FSM entitlement in each cluster are also listed.

For School A (Table 2), the first cluster, comprising 360 students (36.4% of the sample) selected predominantly juice-based drinks, with a mean NME sugar intake of 20.2g/student-day from beverages. The second cluster, which had a similar number of students (*n*=357; 36.1% of the sample) purchased an assortment of beverages, and had the highest mean volume of pure juice (60.7ml/student-day), hot drinks (7.3ml/student-day) and plain milk (3.1ml student-day), whilst having the lowest mean total beverage volume (298.2ml/student-day). The next cluster comprised 94 students (9.5% of the sample), who predominantly selected water (296.9ml/student-day), and had the lowest mean NME sugars of all clusters (8.6g/student-day). There were two similar sized clusters that tended to purchase flavoured milk – the first 'milk' cluster (*n*=77, 7.8% of the sample) predominantly purchased 200ml cartons (50p) whilst the second 'milk' cluster (*n*=67, 6.8% of the sample) purchased 200ml bottles (65p). For both these 'milk' clusters the total NME sugar was almost identical ('cartoned flavoured milk', 15.4g/student-day; 'bottled flavoured milk', 15.2g/student-day), as was the total beverage volume ('cartoned flavoured milk', 320.0ml/student-day; 'bottled flavoured milk', 319.8ml/student-day). There was a final cluster comprising 35 students (3.5% of the sample) who purchased high volumes (424ml/student-day) of juice-based drinks, giving an exceptionally high mean NME sugar of 28.6g/student-day, and the highest overall volume of beverages (524.0ml/student-day).

The first cluster for School B (Table 3) comprising the majority of students (*n*=468; 55.8% of the sample), purchased an assortment of beverages. Whilst this 'assorted' cluster had the lowest total beverage volume (305.1ml/student-day), it also recorded the highest total volume of hot drinks (22.9ml/ student-day), pure juice (excluding sparkling juice) (24.6ml/student-day) and plain milk (18.8ml/student-day). The second cluster, comprising 111 students (13.2% of the sample), tended to purchase still water alongside combination drinks, with an average content of 13.2g/student-day NME sugars. The third cluster of 96 students (11.5% of the sample), predominantly purchased sparkling juice/juice-based drinks; their mean level of NME sugar from beverage purchases was high (19.3g/student-day). There were two clusters of students who mainly chose water. The first of these 'water' clusters (*n*=86, 10.3% of the sample) selected on average 334.4ml of water per student-day, whilst the second 'water' cluster (*n*=46, 5.5%) purchased on average 522.4ml of water per student-day, and had the highest overall volume (564.2ml/student-day) of all clusters. These 'water' clusters had the lowest mean NME sugars (6.3g/student-day and 2.2g/student-day, respectively). Finally, there was a small cluster (*n*=31, 3.7% of the sample) distinctive by the high volumes of juice-based drinks selected (372.6ml/student-day). Most of these were one particular beverage (312.3ml/student-day) which was unique as a bottled juice-based drink. Students in this 'high volume juice-based' cluster had a high mean NME sugar level (24.4g/student-day).

The volume ranges of total beverages selected at both schools were similar (School A, 298-524ml/student-day; School B, 305-564ml/student-day). Among the clusters at both schools, the mean values for the NME sugars derived from beverage selections were high and for two 'juice-based' clusters at each school, these values exceeded the upper limit of the nutrient-based standards (effective at the time of the study) for NME sugars.

The proportion of FSM students in each cluster varied (School A, 2.9-12.9%; School B, 23.9-41.9%). FSM entitlement in students in School B selecting beverages on ten or more days (31.9%) was significantly higher than for students selecting beverages (23.0%) for any number of days (Chi-squared=114.7, df=1, $p<0.001$).

The estimated marginal means of NME sugar content from purchased beverages, according to cluster is shown in Table 4. For School A, the ANCOVA showed that there was a hierarchy in NME sugar content according to cluster membership. The two clusters of students with a preference for juice-based drinks had the highest intake of NME sugars. Students in the 'high volume juice-based' cluster returned approximately three times the NME sugar content in beverage purchases compared to the cluster of students predominantly purchasing water. It should also be noted that the students in the 'high volume juice-based' cluster purchased beverages containing a statistically significantly ($p<0.05$) greater quantity of NME sugars than the students in the other juice-based cluster.

For School B, the ANCOVA analysis showed that there was a clear gradient in NME sugar content according to cluster. Students in the 'high volume juice-based' cluster had significantly greater NME sugar content from beverages than any other cluster. This cluster returned approximately twice the NME sugar level of the students in the 'assorted drinks cluster', whilst students in both 'water' clusters had substantially lower NME sugar levels from beverages purchased than other clusters.

Discussion

This study adds to the current literature on beverage patterns in adolescents and the debate surrounding juices and juice-based drinks. The use of cluster analysis allowed the segmentation of the student body according to beverage purchase patterns, and revealed the extent of adolescents' preference for these beverages, and the subsequent implications on NME sugar intake.

The popularity of juices and juice-based drinks among adolescents shown in this study, mirrors that seen in the UK as a whole. Since the commercial production of orange juice in the 1940s, the industry has seen an increase in the variety, marketing and distribution of fruit juices.[18] Today, the sector enjoys almost universal appeal, with sales estimated at £4.8 billion in 2013, and forecast for growth to £5.4 billion by 2018.[19] Previous work has demonstrated the popularity of fruit juice and juice-based beverages among adolescents,[20,21] as well as how this impacts on the sugar intake of school children.[22] Further, the substantial contribution of beverages to a population's daily energy intake has been previously reported,[23] as has the increasing beverage consumption in UK adolescents.[24]

The contribution of pure juices and juice-based drinks to students' theoretical NME sugar intake, as demonstrated by this study has been revealing. Whilst diluted fruit juice is permitted by the school food standards in England, pure juice must constitute a minimum of 50% (at the time of the study) of the final juice-based drink (45% under the new standards[9]). This study shows that juice-based drinks of this composition can contribute a considerable amount of NME sugars. At both schools, juice and juice-based drinks were available in smaller volume sizes e.g. 185ml juice-based drink with 10.2g NME sugars. However, students sometimes purchased two or more of these smaller volume beverages; 6.2% of transactions for these beverages were multiple units, thereby negating the desired impact of smaller unit sizes. Nevertheless, an emphasis on reduced sizes for beverages could be a way forward. Similar strategies have reduced portion sizes in US schools,[25] and the new school food standards in England[9] introduced in 2015, specifies a cap of 150ml on pure fruit juice, and 330ml on juice-based drinks.

The well-defined beverage patterns that emerged are comparable to previous studies[17,26]; as are the high energy intakes from beverages reflected in the high NME sugar levels noted. This high energy intake from beverages may be compounded by food choice at lunchtime, as well as food and beverage choice outside school. It is interesting to note that the 'assorted' clusters had the lowest overall volume of beverages selected; this has been seen in previous studies[26] where no beverage or beverage type dominates.

Both schools' most popular drink was juice-based. Whilst School A's was 330ml in volume and priced at 70p, School B's was 185ml and 40p. The difference may be attributable to differences in the schools' FSM profiles (School A: FSM 9%; School B: 17%), as both drinks were available at both schools, and the schools had similar set ups for students to select their beverages.

There are strengths and limitations to this study. The beverage selections reported are for more than two thousand secondary school students over a period of seven months. The extent and size of this data demonstrates the feasibility and power of using such data, as previously reported.[4,27] Whilst being discreet, and effortless as far as the participant is concerned, such data provide an accurate and long-term account of dietary choices compared to typical self-reported dietary data.

This study is based on beverage purchase data, and whilst choice, rather than consumption was evaluated, choice is the overriding factor influencing consumption. The dietary data collected are for a restricted environment with school compliant beverages available for students to select, and so the patterns observed are qualified by these constraints. As with any cluster analysis, there is an element of subjectivity in determining the optimum number of clusters and their definition. Whilst the patterns may be specific to the study's populations, and there is the possibility that the schools are atypical, the schools were large and there was no obvious demographic characteristic to set them apart from the mainstream. Furthermore, both school populations showed similar overall beverage choice patterns, despite their differences in FSM profiles (School A: FSM 9%; School B: 17%).

Fruit juice consumption has been reported as a marker for healthier overall dietary habits,[20] with adolescent juice consumers having higher intakes of fibre, vitamin C, B6, folate, potassium and iron, compared to non-consumers.[28] There are however concerns surrounding fruit juice, based on sugar consumption and appetite control, as well as fibre intakes and dental health.[29,30] Indeed, the energy density and sugar content of fruit juice are similar to sugar sweetened beverages.[31] There is also a growing body of evidence surrounding the role of sugar in Type 2 diabetes, independent of its role in obesity, with emerging data on the association of fruit juice with cardiometabolic outcomes,[32,33,34] suggesting it may be consistent with that of sugar sweetened beverages. Fruit juice however does provide micronutrient value not afforded by sugar sweetened beverages.

The role of water has been highlighted by this study. 'Water' clusters at both schools exhibited the lowest NME sugars from beverages. Further, whilst School A had water fountains conveniently located throughout the school, School B's provision was more restricted, with water jugs present at mealtimes for students' free access – this differing water provision was reflected in the higher water purchases and the presence of two 'water' clusters at School B. Other studies have demonstrated the impact of water provision on students' consumption.[35,36]

The promotion of water alongside whole fruit (typically available in secondary schools in England and available in this study's schools) is suggested as an alternative to the dominant position of fruit juice and juice-based beverages. Replacement of fruit juice with its equivalent whole fruit has been modelled to show a reduction in energy intake, as well as an increase in fibre.[37] In addition, water consumption is associated with a reduced risk of being overweight,[36] and lower total energy intake when replacing other beverages.[38]

This study revealed the extent of adolescents' preference for juice and juice-based drinks within a school environment. Beyond the immediate impact on students' nutrient intake, this preference has implications should this consumption enhance explicit preference for sugar, as previously reported,[39] and is especially pertinent as taste has been reported to have the greatest influence on children's food preferences.[40]

The school dining environment influences students in terms of the food and beverages available to them and the behaviour that these choices cultivate. Whilst the standards restrict the beverages available in schools, students' preferences and patterns of beverage choice should also be considered in determining the standards. This study clearly shows the contribution of students' beverage preferences to their NME sugar intake. This, along with emerging data related to these beverages and cardiometabolic outcomes should open discussion regarding fruit juice and juice-based beverages' standing in schools.

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Conflict of interest: The authors declare no conflict of interest.

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FIGURE LEGENDS

Figure 1 Beverage choice among students (n=1222, School A; n=1239, School B) aged 11-18 years at two secondary schools (number of beverages chosen as a percentage of all beverages chosen: School A, 82 497 beverages; School B, 58 479 beverages)

Figure 1 Beverage choice among students (School A, n=1222; School B, n=1239) aged 11-18 years at two secondary schools (number of beverages chosen as a percentage of all beverages chosen: School A, 82 497 beverages; School B, 58 479 beverages)

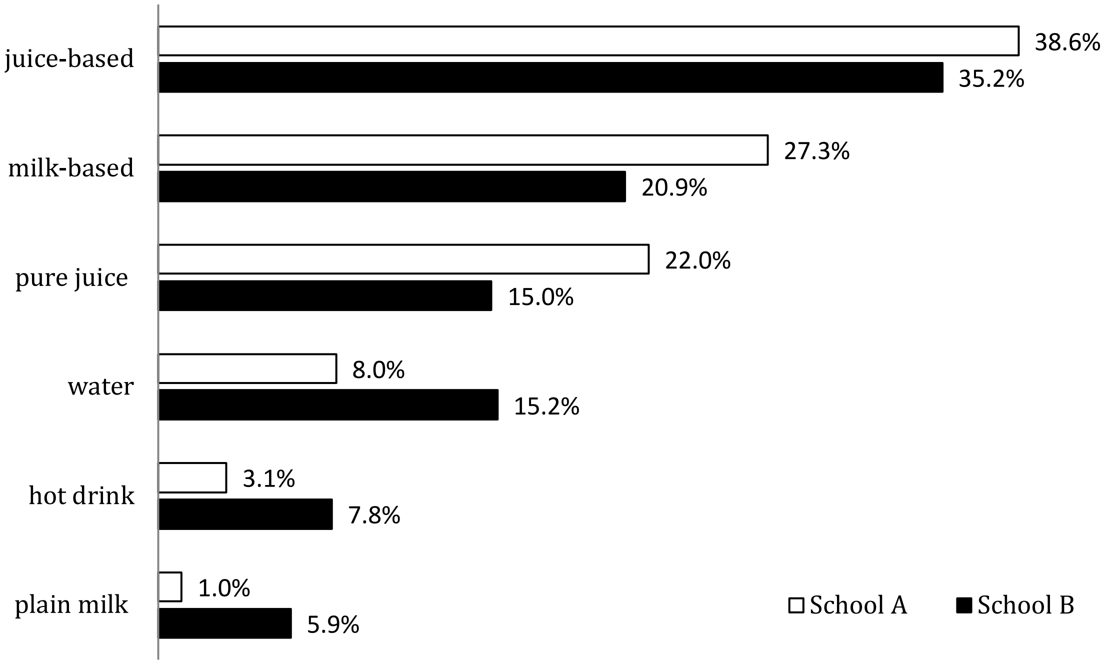

Table 1 Beverage descriptions, NME sugar content, energy content & beverage choice among 11-18 year old students (School A, n=1222; School B, n=1239) at two secondary schools

	NME Sugars (g)	Energy		Volume (ml)	Description	Number purchased	Beverage category
		(kJ)	(kcal)				
School A							
	17.8	303.6	72.5	330	50% juice + carbonated water	10754	Juice-based
	27.5*	360.0	86.0	500	50% juice + water	10424	Juice-based
	8.4	504.0	120.4	200	flavoured milk drink	9894	Milk-based
	9.6	520.0	124.2	200	flavoured milk drink	8698	Milk-based
	0	0.0	0.0	500	still water	6583	Water
	18.4	320.0	76.4	200	pure juice	6406	Pure Juice
	10.2	133.2	31.8	185	50% juice + water	5468	Juice-based
	20.4*	360.0	86.0	200	smoothie drink	5185	Juice-based
	8.4	548.0	130.9	200	flavoured milk drink	3958	Milk-based
	9.5	171.7	41.0	85	pure juice	3925	Pure juice
	29.7*	587.4	140.3	330	pure juice	3271	Pure juice
	22.4*	404.0	96.5	200	pure juice	2663	Pure juice
	0	0.0	0.0	150	hot drink	2523	Hot drink
	9.5	171.7	41.0	85	pure juice	1882	Pure juice
	0	366.7	87.6	189	semi-skimmed plain milk	863	Plain milk
School B							
	10.2	133.2	31.8	185	50% juice + water	9142	Juice-based
	0	0.0	0.0	500	still water	8895	Water
	9.6	520.0	124.2	200	flavoured milk drink	6223	Milk-based
	0	0.0	0.0	150	hot drink	4551	Hot drink
	8.4	504.0	120.4	200	flavoured milk drink	4517	Milk-based
	17.8	303.6	72.5	330	50% juice + carbonated water	4395	Juice-based
	27.5*	360.0	86.0	500	50% juice + water	4281	Juice-based
	0	366.7	87.6	189	semi-skimmed plain milk	3475	Plain milk
	9.5	171.7	41.0	85	pure juice	2985	Pure juice
	27.7*	679.8	162.4	330	sparkling pure juice	2835	Pure juice
	18.4	320.0	76.4	200	pure juice	1613	Pure juice
	8.4	548.0	130.9	200	flavoured milk drink	1457	Milk-based
	29.7*	587.4	140.3	330	pure juice	1310	Pure juice
	18.2	237.6	56.8	330	50% juice + water	1099	Juice-based
	30.2*	524.2	125.2	288	85% juice + water	928	Juice-based
	17.8	326.7	78.0	330	50% juice + carbonated water	317	Juice-based
	20.4*	360.0	86.0	200	smoothie drink	251	Juice-based
	25.1*	531.3	126.9	330	75% juice + water	154	Juice-based
	8.4	536.0	128.0	200	flavoured milk drink	34	Milk-based
	24.0*	1300.0	310.6	500	flavoured milk drink	17	Milk-based

* single unit's NME sugar level exceeds 18.9g (upper limit of nutrient-based standard for NME sugars - effective at the time of the study)

Table 2 Mean volume and NME sugars from beverages, as well as FSM entitlement and Year Group, by beverage cluster for students (n=990) aged 11-16 years at School A

	Juice-based	Assorted	Water	Cartoned flavoured milk	Bottled flavoured milk	High volume juice-based
	n = 360	*n* = 357	*n* = 94	*n* = 77	*n* = 67	*n* = 35
Beverage selection by cluster (ml/student-day)						
Total pure juice beverages	51.6	60.7	25.9	30.1	24.1	38.5
85ml pure juice	*2.6*	*2.6*	*0.9*	*1.6*	*1.9*	*2.5*
85ml pure juice	*5.8*	*6.4*	*2.5*	*3.3*	*2.3*	*3.9*
200ml pure juice	*13.7*	*29.3*	*13.0*	*9.1*	*11.8*	*14.2*
200ml pure juice	*5.6*	*10.4*	*3.2*	*7.8*	*2.7*	*3.1*
330ml pure juice	*23.9*	*12.0*	*6.3*	*8.3*	*5.4*	*14.8*
Total juice-based beverages	231.5	135.7	80.3	72.1	72.4	424.1
185ml 50% juice + water	*11.8*	*29.3*	*8.7*	*11.0*	*4.8*	*4.7*
500ml 50% juice + water	*117.9*	*46.3*	*38.9*	*24.4*	*31.2*	*331.0*
330ml 50% juice + carbonated water	*88.6*	*37.9*	*22.3*	*24.5*	*23.7*	*83.0*
200ml smoothie drink	*13.2*	*22.2*	*10.4*	*12.2*	*12.7*	*5.4*
Total milk-based beverages	41.9	57.4	29.1	185.1	175.7	31.4
200ml flavoured milk	*12.3*	*17.0*	*8.5*	*34.9*	*151.9*	*11.5*
200ml flavoured milk	*16.3*	*12.2*	*7.9*	*6.4*	*4.8*	*6.6*
200ml flavoured milk	*13.3*	*28.2*	*12.7*	*143.8*	*19.0*	*13.3*
1/3 pint semi-skimmed plain milk	1.7	3.1	1.6	2.3	2.1	3.0
500ml still water	27.6	34.2	296.9	26.2	42.0	23.9
150ml hot drink	5.5	7.3	4.5	4.1	3.5	3.0
All beverages	359.7	298.2	438.1	320.0	319.8	524.0
NME sugars by cluster (g/student-day)	20.2	16.8	8.6	15.4	15.2	28.6
Characteristics by cluster						
FSM status	10.0%	12.9%	7.4%	9.1%	6.0%	2.9%
Year group						
Year 7	32.8%	24.4%	7.4%	24.7%	17.9%	17.1%
Year 8	22.2%	20.2%	16.0%	19.5%	14.9%	5.7%
Year 9	17.2%	24.1%	21.3%	22.1%	23.9%	22.9%
Year 10	14.2%	15.1%	31.9%	16.9%	28.4%	40.0%
Year 11	13.6%	16.2%	23.4%	16.9%	14.9%	14.3%

Table 3 Mean volume and NME sugars from beverages, as well as FSM entitlement and Year Group, by beverage cluster for students (n=838) aged 11-18 years at School B

	Assorted	**Water with juice-based**	**Sparkling juice / juice-based**	**Water**	**High volume water**	**High volume juice-based**
	n = 468	*n* = 111	*n* = 96	*n* = 86	*n* = 46	*n* = 31
Beverage selection by cluster (ml/student-day)						
Total pure juice beverages	41.7	34.9	78.0	16.4	6.2	28.8
85ml pure juice	*6.5*	*4.6*	*4.3*	*2.3*	*0.6*	*2.0*
200ml pure juice	*7.3*	*8.3*	*6.4*	*4.9*	*2.8*	*6.2*
330ml pure juice	*10.8*	*7.6*	*6.5*	*4.5*	*0.5*	*8.7*
330ml sparkling pure juice	*17.1*	*14.4*	*60.8*	*4.7*	*2.3*	*11.9*
Total juice-based beverages	121.6	140.3	191.9	57.8	18.9	372.6
185ml 50% juice + water	*48.0*	*18.3*	*20.4*	*15.1*	*5.3*	*18.1*
288ml 85% juice + water	*5.8*	*7.3*	*6.3*	*4.0*	*1.8*	*1.7*
330ml 50% juice + water	*6.7*	*9.0*	*12.5*	*2.4*	*0.9*	*13.5*
330ml 75% juice + water	*1.0*	*1.0*	*0.9*	*0.8*	*0.2*	*1.5*
500ml 50% juice + water	*35.8*	*81.8*	*25.6*	*21.5*	*6.6*	*312.3*
330ml 50% juice + carbonated water	*21.4*	*20.2*	*119.6*	*12.2*	*3.7*	*22.5*
330ml 50% juice + carbonated water	*2.0*	*1.9*	*5.5*	*1.2*	*0.4*	*1.3*
200ml smoothie drink	*0.9*	*0.8*	*1.1*	*0.6*	*0.0*	*1.7*
Total milk-based beverages	64.9	44.0	38.7	34.6	10.9	24.4
200ml flavoured milk	*31.4*	*16.9*	*20.2*	*15.4*	*2.7*	*11.9*
200ml flavoured milk	*25.5*	*21.1*	*12.6*	*14.5*	*6.6*	*9.0*
200ml flavoured milk	*7.4*	*5.7*	*5.9*	*4.3*	*1.4*	*3.2*
200ml flavoured milk	*0.2*	*0.2*	*0.0*	*0.4*	*0.2*	*0.3*
500ml flavoured milk	*0.4*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*
1/3 pint semi-skimmed plain milk	18.8	8.9	10.7	11.1	3.7	6.8
500ml still water	35.1	168.3	27.2	334.4	522.4	42.0
150ml hot drink	22.9	16.8	12.2	12.2	2.2	7.2
All beverages	305.1	413.4	358.5	466.6	564.2	481.9
NME sugars by cluster (g/student-day)	13.7	13.2	19.3	6.3	2.2	24.4
Characteristics by cluster						
FSM status	31.4%	29.7%	37.5%	31.4%	23.9%	41.9%
Year group						
Year 7	27.8%	23.4%	34.4%	12.8%	13.0%	35.5%
Year 8	22.2%	17.1%	17.7%	18.6%	2.2%	3.2%
Year 9	23.7%	13.5%	25.0%	12.8%	6.5%	6.5%
Year 10	13.2%	21.6%	10.4%	23.3%	23.9%	19.4%
Year 11	9.2%	18.9%	9.4%	15.1%	26.1%	22.6%
Year 12	1.3%	3.6%	2.1%	11.6%	8.7%	9.7%
Year 13	2.6%	1.8%	1.0%	5.8%	19.6%	3.2%

Table 4 Estimated Marginal Means of NME sugar content by beverage cluster and school (School A, n=990 students, 11-16 years ; School B, n=838 students, 11-18 years)

School A

Cluster	Mean*	95% Confidence Interval	
		Lower Bound	Upper Bound
High volume juice-based	22.779[a]	21.474	24.084
Juice-based	18.208[b]	17.703	18.713
Assorted	15.135[c]	14.646	15.624
Bottled flavoured milk	12.952[d]	11.987	13.918
Cartoned flavoured milk	12.830[d]	11.931	13.73
Water	7.890[e]	7.056	8.723

* means with different superscript are significantly different using Tukey HSD from each other ($p<0.05$)

School B

Cluster	Mean	95% Confidence Interval	
		Lower Bound	Upper Bound
High volume juice-based	21.117[a]	19.348	22.886
Sparkling juice/juice-based	16.101[b]	15.035	17.167
Water with juice-based	12.259[c]	11.272	13.246
Assorted	11.963[c]	11.371	12.555
Water	6.660[d]	5.588	7.732
High volume water	3.648[e]	2.185	5.11

* means with different superscript are significantly different using Tukey HSD from each other ($p<0.05$)