Sugars consumption in a low-income sample of British young people and adults

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IN BRIEF

- Provides an overview of macronutrient intakes in two UK populations.
- Improves understanding of the differences in sugars consumption between a deprived and a general population sample.
- Offers insight into how different socioeconomic factors affect sugar consumption in a low income population.

RESEARCH

Objective To report the consumption of non-milk extrinsic sugars (NMES) among a low-income UK sample, compare it with nationally representative estimates and examine the association between socioeconomic position and NMES consumption among low income adults. **Design** Secondary analysis of the Low Income Diet and Nutrition Survey (LIDNS) data. **Setting and subjects** Two thousand, seven hundred and ninety-six adults and 415 young people from 2,477 households. **Main outcome measures** Mean NMES intakes (grams) and their percentage contribution to food energy, from dietary data collected via a 24-hour recall 'multiple pass' method. **Results** The low income sample consumed more NMES than the general population sample. The percentage of food energy from NMES exceeded the 11% target, especially among adolescents (17.2% in males, 16.3% in females). After adjusting for age, men who finished full-time education aged 16 years consumed significantly more sugar ($p = 0.028$), whereas those who finished aged 18 consumed significantly less sugar ($p = 0.023$) than the reference group (finished aged 15). No significant associations were found between NMES and socioeconomic variables in women. **Conclusion** Compared to the general population, the nutritional disadvantage of the most deprived segments of society relates primarily to excessive NMES consumption. In men, higher educational level appears to play a protective role against high sugar intakes.

INTRODUCTION

In the UK, sugars are classified into intrinsic (sugars naturally integrated into the cellular structure of fruit and vegetables) and extrinsic (sugars in free form or added to foods/drinks).[1] Extrinsic sugars are then sub-divided into milk extrinsic sugars found in milk and milk products, and non-milk extrinsic sugars (NMES), which include all added sugars in processed and manufactured foods and drinks and sugars in fresh fruit juices, honey and syrups. A wealth of scientific evidence from a multiplicity of sources including human observational and intervention studies, animal experiments and experimental laboratory studies has consistently shown that NMES are the most important factor in the development of dental caries.[1–3] Both the frequency and amount of NMES consumed are associated with caries.[4]

An increasing body of evidence from experimental, epidemiological and intervention studies internationally also highlights the role of NMES consumption in the development of other chronic conditions, and in particular, weight gain and obesity.[2] More conclusively, systematic reviews and meta-analyses of prospective studies show a clear and consistent association between sugary drinks consumption and obesity and related cardio-metabolic diseases.[5,6] The principal mechanisms linking sugary drinks intake to weight gain are low satiety of liquid calories and incomplete compensatory reduction in energy intake at subsequent meals, leading to an increase in total energy intake.[7]

Based upon the overwhelming totality of scientific evidence, consensus recommendations on sugars consumption have been agreed.[1,2] It is recommended that NMES should provide less than 10% of total energy intake (11% of food energy) or less than 60 g per person per day. Practically, the frequency of intakes of foods and/or drinks containing NMES should be limited to a maximum of four times per day. In contrast, dietary guidelines recommend consuming at least five portions of fruit and vegetables per day due to their beneficial effects on health.

NMES consumption varies across different stages of life. Consumption peaks in adolescence with the majority of young people exceeding the recommended daily amounts,[8] and decreases thereafter.[9] There are also gender differences with males consuming higher amounts than females.[10] Although diet and nutrition are important factors contributing to health inequalities,[11] limited detailed information has been available on NMES consumption among low-income population groups, where health-compromising dietary patterns would be expected to be more widespread. However, a diet survey was conducted between 2003 and 2005 that aimed to assess the nutritional intakes of a nationally representative sample of low-income households across the UK.[12]

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OBJECTIVES

The objective of this study was to report on the consumption of NMES among a low-income sample of UK young people and adults, and to compare this with data from a UK nationally representative general household sample. We also then looked at the association between socio-economic position and NMES consumption among the sample of low income adults, after adjusting for the effect of age.

STUDY DESIGN

This study used data collected from the Low Income Diet and Nutrition Survey (LIDNS) for secondary analysis. LIDNS aimed to capture the dietary and lifestyle behaviours of the 15% most deprived households in the United Kingdom. Full details of the survey methodology are reported elsewhere.[12]

SETTING AND SUBJECTS

A five-stage clustered probability sample design was used. Five hundred and twenty-eight wards were selected with oversampling for deprived wards and for Scotland, Wales and Northern Ireland. A fixed sample of addresses (from the small-users postcode address file) were selected for each ward depending on its relative deprivation level. From each address one household was selected. To confirm eligibility a doorstep screening questionnaire was designed consisting of indices of material deprivation such as receipt of benefits, car ownership, employment status, household income and composition. From each household, a maximum of two individuals were selected; a child and an adult or two adults (if there were no children in the household). Participants were excluded if they were younger than two years old or pregnant.

Overall 3,728 participants from 2,477 households took part in LIDNS. Demographic and household information (age, gender, level of education, income and work status are the variables used in this analysis) was obtained through an interviewer-administered computer assisted personal interview (CAPI) questionnaire carried out face-to-face as well as various self-complete questionnaires.

For the purposes of this study, 2,796 adults (aged 19 years and over) and 415 young people (aged 11-18 years) were analysed. Children aged two to ten years (n = 517) were not included.

Table 1 Demographic characteristics of the adult sample (age ≥19 years) of the Low Income Diet and Nutrition Survey (n = 2796)

		N (%)	N (%)
		Male	Female
Age group	19-34	202 (21)	450 (24.6)
	35-49	207 (21.5)	436 (23.8)
	50-64	231 (24)	302 (16.5)
	65+	321 (33.5)	643 (35.1)
	Missing	0	0
Age finished full-time education	15 or under	527 (54.7)	935 (51.1)
	16	252 (26.2)	552 (30.1)
	17	36 (3.8)	104 (5.6)
	18 or over	100 (10.4)	159 (8.7)
	Still in FT education	45 (4.7)	75 (4.1)
	Missing	2 (0.2)	8 (0.4)
Equivalised net weekly household income*	1st tertile (lowest)	266 (27.7)	376 (20.5)
	2nd tertile	198 (20.6)	445 (24.3)
	3rd tertile (highest)	204 (21.2)	436 (23.8)
	Missing	293 (30.5)	574 (31.4)
De facto marital status	Married	310 (32.2)	351 (19.3)
	Cohabiting	94 (9.8)	107 (5.8)
	Single	276 (28.7)	417 (22.7)
	Widowed	119 (12.3)	449 (24.5)
	Divorced/separated	164 (17)	508 (27.7)
	Missing	0	0
Employment status	Working	108 (11.2)	223 (12.2)
	Unemployed	810 (84.1)	1534 (83.7)
	In full time education	45 (4.7)	75 (4.1)
	Missing	0	1 (0)
Base (unweighted)		946 (100)	1850 (100)

*Tertiles of equivalised net weekly household income (excluding disability living allowance, incapacity benefit and attendance allowance) are: 1st (lowest): less than £83.01/week; 2nd : £83.02-£126.38/week; 3rd (highest): more than £126.39/ week

MAIN OUTCOME MEASURES AND DATA COLLECTION

The main outcome measure was the mean NMES intake (in grams) and their percentage contribution to food energy. Dietary information was collected by four 24-hour recalls on random days (including at least one weekend day) within a ten-day period using the triple pass method. The interviewer first asked the respondent to give a quick list of all food and drink consumed in the past 24 hours without any interruptions (first pass), then went through the quick list and asked for additional information such as portion sizes and brands (second pass) and finally probed the respondent to add any other food or drink that may have been missed during the previous stages (third pass). Portion

Table 2 Mean daily energy and macronutrient consumption, by age group and gender

	Male						Female					
Age groups	11-18		19-64		65+		11-18		19-64		65+	
Energy												
	LIDNS N = 200	NDNS N = 238	LIDNS N = 678	NDNS N = 346	LIDNS N = 268	NDNS N = 96	LIDNS N = 215	NDNS N = 215	LIDNS N = 1313	NDNS N = 461	LIDNS N = 537	NDNS N = 168
Mean food energy (kcal/day)	2,224	1,982	2,158	2,032	1,808	1,872	1,866	1,622	1,576	1,560	1,427	1,486
Protein												
Mean intake (g/day)	71.6	73.7	80.3	88.1	69.9	79.7	60.6	57.3	59.7	65.4	57.3	64.2
% Food energy*	13.1	15	16.2	17.7	16.5	17.2	13.3	14.3	16	17.3	16.7	17.5
Total Fat												
Mean intake (g/day)	89.5	75.6	82.9	80.8	70.2	77.7	76.2	63.1	60.9	61.0	56.1	60.0
% Food energy*	36.4	34.1	35.9	35.2	36	37.1	36.3	34.6	35.1	34.4	35.2	35.9
Saturated Fat												
Mean intake (g/day)	33.8	28.3	31.2	29.6	28.3	30.4	28.4	22.9	23.4	22.4	23.3	24
% Food energy*	13.7	12.7	13.4	12.9	14.4	14.5	13.5	12.6	13.4	12.6	14.5	14.3
Total carbohydrate												
Mean intake (g/day)	296.5	268	257.6	255	216.5	228	247.1	220	198.5	200	179.5	184
% Food energy*	50.5	50.9	47.9	47.1	47.5	45.8	50.4	51	48.8	48.3	48.1	46.6
Non-milk extrinsic sugars												
Mean intake (g/day)	102.9	85.6	82.2	71.8	61.5	56.1	80.7	67.1	57.2	52.4	46.8	44.7
% Food energy*	17.2	16	15.2	12.9	13.1	11.2	16.3	15.3	13.5	12.2	12.1	11

*Dietary Reference Values recommendations as a % contribution to food energy are: 35% for total fat and 11% of saturated fat intakes, 50% for total carbohydrate and 11% for NMES. (COMA 1991).

sizes were estimated using weights from food packaging, a photographic food atlas or household measures. The information on the quantities and types of foods consumed was linked to a nutrient database based on data from McCance and Widdowson's *The composition of foods* (sixth edition and supplements) in order to calculate nutrient intakes.[13]

ETHICAL APPROVAL

The study received ethical approval from the London Multi-Centre Research Ethics Committee (MREC).

STATISTICAL ANALYSIS FOR THIS STUDY

PASW Statistics 18 (SPSS Inc, Chicago IL) was used for the statistical analyses. Survey weightings accounted for over-sampling and non-response bias. Demographic characteristics of the participants are presented as frequencies and are stratified by gender. Due to the nature of the socioeconomic variables, young people (215 girls and 200 boys aged 11-18 years) were omitted from the analysis, except for the stage when LIDNS estimates were compared with those for the whole population. For that, mean macronutrient intakes were compared with data from the rolling National Diet and Nutrition Survey[14] (NDNS, years one and two combined) and their percentage contribution to food energy intake was compared to the UK dietary reference values (DRVs).[15] DRVs are population estimates for nutrient requirements and dietary recommendations set by the Committee on Medical Aspects of Food and Nutrition Policy (COMA). In order to allow for direct comparisons, the age group categories from the LIDNS have been collapsed to match those from the rolling NDNS (11-18 years, 19-64 years, 65 years plus).

Multiple linear regression was used to explore the relationship between NMES intake and various socioeconomic factors. NMES were used as the dependent variable and the following as independent variables: age of leaving full-time education (15 years old or less; 16 years old; 17 years old; 18 years old and above; still in full time education), equivalised net household weekly income (valid values only, tertiles) and work status (working; unemployed; in full time education). All models were stratified by gender and adjusted for age (continuous).

RESULTS

The analytical sample consisted of 946 men and 1,850 women aged ≥19 years; their demographic characteristics are presented in Table 1. The mean age of the males in the sample was 52.6 years (SD 1.9) and for females was 52.6 years (SD 2.1). The majority of the sample (54.7% of men and 51.1% of women) finished school aged 15 years or under (low education group). The mean equivalised net weekly

Table 3: Crude and age adjusted mean daily NMES intakes of adults according to socio-economic characteristics and stratified by gender

		Males				Females			
		Crude		Age adjusted		Crude		Age adjusted	
		B (95% CI)	P	B (95%CI)	P	B (95% CI)	P	B (95% CI)	P
Age finished full-time education	Reference (15 or under)	74 (70, 78)		104 (93, 114)		53 (51, 55)		74 (68, 79)	
	16	13 (8, 20)	<0.001	8 (1, 15)	0.028	3 (-0.6, 7)	0.099	-0.7 (-4, 3)	0.706
	17	1 (-12, 15)	0.850	12 (-2, 26)	0.100	0.3 (-7, 7)	0.936	5 (-2, 11)	0.176
	18 or over	-8 (-17, 2)	0.105	-11 (-20, -1)	0.023	2 (-4, 8)	0.481	0.1 (-5, 6)	0.968
	Still in FT education	-2 (-15, 11)	0.777	-5 (-18, 7)	0.399	-2 (-9, 6)	0.633	-1 (-9, 6)	0.696
Equivalised net weekly household Income*	Reference (1st Tertile-lowest)	77 (73, 81)		104 (94, 114)		55 (52, 57)		74 (68, 79)	
	2nd Teritle	-6 (-12, -0.9)	0.023	-3 (-9, 2)	0.199	-2 (-4, 1)	0.217	0.3 (-2.4, 3)	0.815
	3rd Tertile (highest)	7 (1, 12)	0.013	4 (-2, 9)	0.176	2 (-0.7, 5)	0.147	-0.2 (-3, 3)	0.879
Employment	Reference (Working)	90 (81, 100)		110 (99, 122)		57 (53, 61)		72 (66, 78)	
	Unemployed	-17 (-27, -6)	0.002	-4 (-15, 7)	0.460	-4 (-9, 0.7)	0.098	2 (-3, 7)	0.346
	Still in full-time education	-13 (-31, 5)	0.159	-18 (-36, 0)	0.050	7 (-0.6, 15)	0.073	1 (-7, 9)	0.772

*Tertiles of equivalised net weekly household income (excluding disability living allowance, incapacity benefit and attendance allowance) are: 1st (lowest): less than £83.01/week; 2nd : £83.02-£126.38/week; 3rd (highest): more than £126.39/ week

household income was £113.60. Just over 10% of the sample were working with the majority (84%) being unemployed at the time of the survey. The demographic profile of the sample confirms the deprived nature of the survey population.

When the mean macronutrient intakes and their food energy values from the low-income sample were compared to the findings for the general population (Table 2), the only major difference between the two samples was found in relation to NMES consumption. The low income sample, both males and females, across age groups consistently consumed more NMES than the general population sample. The dietary recommendation for NMES is not to exceed 11% of food energy (excluding alcohol).[1] In the low income sample, the percent energy from NMES consistently exceeded this target especially among adolescents. For males and females aged 11-18 years NMES intakes were 103 g (17.2% total food energy) and 81 g (16.3% total food energy) respectively.

As expected, for both men and women the consumption of NMES steadily decreased with age. There were no significant differences in NMES consumption between the different socioeconomic groups for all relevant variables (education, income and work status) in women, both without and also after adjusting for age (Table 3).

In men, however, those who finished full-time education at the age of 16 years consumed significantly more NMES (an additional eight grams per day; p = 0.028) compared to those who finished full-time education at the age of 15 years or less (the reference group) after adjusting for the effect of age group. The relationship between age of finishing full-time education and sugar consumption was reversed for men who finished school at 18 years of age, with the latter group consuming 11 grams less NMES per day than the reference group (low education) after adjusting for age (p = 0.023). There we no significant differences in NMES consumption between either income or employment groups in the age-adjusted models, though men who were still in full-time education consumed less NMES per day (18 grams) than working men and this association was marginally insignificant (p = 0.05).

DISCUSSION

This study reported on the NMES consumption among a low-income national sample of young people and adults, and compared it with the respective consumption from a general household sample. The term 'low income' was used in the broader context of material disadvantage and was not based on income alone but on a set of multiple indices of deprivation designed for the purposes of the survey. The LIDNS sample is certainly very deprived in nature with low levels of educational achievement, low household incomes and very high levels of unemployment. Compared to the general population sample of NDNS, there was considerably and significantly higher consumption of NMES in the low income

sample, among both males and females and across age groups. The differences in NMES consumption were higher for men, particularly so among 11-18-year-olds (the low income sample consumed daily 17.3 g more than the general population) and then for the main adult group of 19-64-year-olds (with a respective difference of 10.4 g daily), but were much more modest for older people. Significant differences were partly expected, as they are in line with previous studies that indicated a graded relationship between NMES and deprivation in the general population, whereby the consumption was higher for each more deprived group.[16,17]

In contrast, it was very surprising to identify that this difference in NMES consumption was the only noteworthy and consistent difference in the dietary intakes between the low income and the general household sample. This indicates that the nutritional disadvantage of the most deprived segments of the population is primarily down to the excessive consumption of sugars. Excessive sugar consumption is a public health concern, as it directly contributes to the high prevalence of obesity in the population. Nutritionally, it highlights a shift towards energy dense foods usually to the expense of nutrient dense foods, such as fruits and vegetables.[18] The former are cheaper,[19] thereby linking this nutritional disadvantage to the availability of material resources. When further analysis was undertaken to determine in greater depth the effect of socio-economic factors on NMES intakes in this deprived sample, there were some significant findings for men but not for women. Most of these significant differences were explained when the results were adjusted for age and therefore were accounted for by the variation in age distribution between the different socioeconomic position groups. The limited role of socioeconomic position in NMES intakes is in contrast to the findings from other studies on general populations and may be attributed to the nature of this sample. LIDNS sampled from the 15% more deprived households in UK, therefore it is not a general population sample and essentially lacks the necessary variation that would allow for differences between socioeconomic groups. However, there was variation in NMES consumption by education level among men even after adjusting for age. Compared to the lowest educated group, men that finished full-time education when they were 16 years old consumed 8 g more daily; in contrast, the most educated group consumed 11 g fewer daily. While this complex pattern deviates from the aforementioned graded relationship between NMES and deprivation,[16,17] it has similarities with a study in the US; for higher levels of income up to a certain level there was higher NMES intake, but the richer groups in the population had lower NMES intake.[20] This relationship may be explained by the combination of two factors: disposable income and health literacy/knowledge. The most deprived sections of the society may be lacking enough income even for their basic needs, therefore their consumption of food – including unhealthy options, such as NMES – is limited. Compared to this group, those slightly less deprived have some disposable income but also a lack of nutritional knowledge that could lead to unhealthier diet choice; in contrast, the least deprived participants may be more health-aware and avoid consuming foods high in NMES, irrespective of whether they can afford them. More importantly, our findings extend beyond the general population and indicate that there are socioeconomic inequalities, mostly related to education, in NMES consumption even among the most deprived groups in society. It seems that among this deprived group of men, relatively better education (up to a point) was associated with worse dietary patterns of higher NMES consumption, possibly reflecting the higher purchasing power of these not totally deprived groups when compared to the worst off. But the highest educated group among the low income population benefited from relatively lower sugar consumption. In a way, high education level among men was protective against the nutritional dietary pattern that comes from belonging to a low income population.

Our findings have important practical implications for public health. In parallel with health promotion initiatives for the whole population, the excessive consumption of NMES among this deprived subgroup of the population calls for public health actions targeting deprived communities in our society. Furthermore, the finding that this disadvantage was considerably reduced for the most educated groups points out the potential benefits from broader policy interventions that tackle the root causes of social inequalities.

One of the concerns of the survey was how truly representative the sample was. As mentioned previously, the screening questionnaire consisted of a number of indices of material deprivation and provided a snapshot of the sample's circumstances at that particular time point. However, comparison with other national surveys confirmed that the sample of LIDNS was indeed deprived and represented a low income population.

Another limitation is that the two surveys compared in this paper used different methodology in assessing nutrient intake. The rolling NDNS used a four day estimated diary whereas LIDNS used a triple pass diet recall. Both surveys recorded the same amount of days and in a comparison study done before the start of the rolling programme it was found that both methods had similar response rates and there were no major differences between the two.[21]

This study benefited from using a nationally representative sample of a materially deprived population in the UK and the data contained a comprehensive set of nutrition related variables. However, the LIDNS collected data through dietary recalls, which are prone to misreporting, particularly among overweight and obese individuals.[22] Furthermore, our analyses would have been more comprehensive if there were data available on environmental factors related to sugars consumption.

CONCLUSION

Using data from the first national study on a low income UK population, we showed that compared to the general population the nutritional disadvantage of the most deprived segments of society relates primarily to excessive NMES consumption. In men, leaving school at 18 years of age was associated with a lower consumption of NMES compared to those leaving at 16, even among this most deprived group.

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