

Intake of Ultra-processed Foods Among Adolescents From Low- and Middle-Income Families in Delhi

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Objective: To assess the contribution of ultra-processed foods to the macronutrient intake of adolescents from low- and middle-income families in Delhi.

Method: Adolescents ($n=1030$) aged 12-16 years from four private and four government schools of Delhi were interviewed using 24-hour recall (repeated on three days), and a food frequency questionnaire.

Results: The mean energy intake from ultra-processed foods was 371 kcal (16.2%) of the total energy intake. The mean intake of macronutrients from ultra-processed foods was 7.1 g (16.3%)

fat, 78.9 g (18.6%) carbohydrate and 4.8 g (10.9%) protein. Children from middle-income families consumed significantly higher ($P<0.05$) amounts of macronutrients coming from ultra-processed foods, as compared to those from low-income families.

Conclusion: Adolescents reported regular consumption of variety of ultra-processed foods, and measures to reduce this consumption and encouraging healthy food choices are urgently needed.

Keywords: Diet quality, Fast food, HFSS foods, Obesity.

A new classification of foods based on the extent and purpose of their processing has been developed as per a tool known as NOVA [1]. Foods are classified as minimally processed foods like pasteurized milk, packaged grains *etc.*, processed culinary ingredients like flours, sugar *etc.*; processed foods like butter; and ultra-processed foods, which are “extraction of substances from whole foods followed by their subsequent assembling with lots of additives and processing aids enabling the manufacture of products with long shelf-life, improved palatability *etc.* like breads, cookies, biscuits and ready to serve beverages [1]. Adolescents in India face a triple burden of malnutrition, overweight and micronutrient deficiency [2]. Excessive intake of energy from foods high in fat, sugar and salt (HFSS) leads to obesity and associated co-morbidities [3,4]. Ultra-processed foods tend to be high in fat and sugar and increase the energy density of the diet [5,6].

Indian studies on the consumption of ultra-processed foods are few and are focused on limited foods. The present study assesses the contribution of ultra-processed foods to the macronutrient intake in diets of adolescents (aged 12-16 year) from low- and middle-income families in Delhi.

METHODS

The study was conducted in one purposively selected

private and government/government-aided school each from North, South, East and West zones of Delhi between July, 2014 and July, 2016. Children from government schools belonged to low-income group and children from private schools belonged to middle-income group, which was verified using Kuppuswamy scale of socio-economic status (SES) classification [7]. Adolescents aged 12-16 years were enrolled by random selection of one section each from 7-11 grades in the respective schools.

A diet survey was carried out by using a pre-tested food frequency questionnaire and a 24-hour food record. The respondents were asked to record their frequency of consumption in the questionnaire, and actual consumption of foods and beverages for three days *i.e.* two working days and one holiday, in a food record. Intake of a food at least three times or more per week was considered as frequent consumption. The amount of food products consumed was assessed by using three and two-dimensional food models of standardized plates, glasses, spoons, ladles and bowls. For foods like chips, ready-to-serve beverages and confectionery, pack sizes were noted in order to assess the child's dietary intake for that food product. Ethical clearance was taken from the institutional ethics committee of Lady Irwin college. Written consent was taken from parents and assent from the school children.

Nutrient intake was calculated by using dietary assessment software, Diet Cal Version 5 (Profound Tech

Solutions Pvt. Ltd., Delhi, India) utilizing the nutrient composition data given by National Institute of Nutrition [8]. The contribution of all ultra-processed foods to the macronutrient intake in day's diet was assessed and compared across the income groups using an independent *t*-test or Mann-Whitney U test. P values less than 0.05 were considered as statistically significant.

RESULTS

Out of 1200 children recruited, 1030 (86%) adolescents (46% from private schools) were present on the day of collection of forms and provided completed forms.

The majority of adolescents (92%) consumed ultra-processed food items frequently. The mean daily intake of ultra-processed foods across income groups is shown in **Web Table I**. It was higher in middle-income group than low-income group. The contribution for macronutrients from ultra-processed foods across income groups was higher in middle-income group as compared to low-income group **Table I**. About 11-19% of daily macronutrient intake was from ultra-processed foods. The maximum contribution to energy intake from ultra-processed foods was by bakery products, followed by beverage concentrates.

DISCUSSION

The present study shows high intake of ultra-processed foods in the majority of adolescents, which was higher in middle-income group than low-income group. Intake of few ultra-processed food products has been reported in literature [2,5,9-13]. The mean consumption of carbonated beverages, fruit juices, ice creams and ready to serve fruit beverages was higher in a study [10] from developed countries than the present study. Previous studies [5,12] have reported lower mean intake of carbonated beverages than the present study. Data show a higher consumption of aerated drinks and chips regularly in school children in Delhi than the present study. This may be due to the difference in sample, age and income group studied.

Data from Comprehensive National Nutritional Survey [2] and National Nutrition Monitoring Bureau [13] reported that the intake for macronutrients and micronutrients was less than the recommended dietary intake (RDA) (10-19 year old children). Similar findings were reported in a study done in Delhi [9]. The present study did not look at the nutritional status of participants. However, a high consumption of ultra-processed foods, most of which are high in fat, salt and sugar and lacking in micronutrients, is disturbing. The fact that half the sample size was from low socio-economic groups shows that income is not a limiting factor and ultra-processed foods have penetrated all segments of society.

A limitation of the study was the difficulty in assessing portion sizes when respondents did not eat a full packet of the packaged product (*e.g.* chips) or a full portion size (*e.g.* piece of cake rather than a defined slice). Assessing the nutritional status of the respondents would have added more information.

Many reasons have been proposed for the high consumption of ultra-processed foods by children [2,5,13-15]. Consumption of these foods in excess could increase the risk of obesity and associated co-morbidities at a younger age. Attention needs to be given to availability of energy dense and HFSS ultra-processed foods in the home and school food-environment so that these foods do not replace fresh home cooked meals. Early introduction to the concept of healthy food choices in schools could help in ensuring better eating habits among growing children. The food industry also needs to pitch in by making available healthier food and beverage options which improve the nutritional quality of the diets of children of this country.

Contributors: AJ: design of study, data collection, data analysis and interpretation, writing paper; PM: design of study, data interpretation, writing and review of paper.

Ethics clearance: Institutional Ethics Committee of Lady Irwin College; ECR/12/INDT/DL/2014 dated May 06, 2014.

Table I Contribution of Ultra-processed Foods to Total Macronutrient Intake of Adolescents

Macronutrients	Middle-income family (n=475)		Low-income family (n=555)		All adolescents (n=1030)	
	Intake, mean (SD)	% Contribution	Intake, mean (SD)	% Contribution	Intake, mean (SD)	% Contribution
Energy (kcal)	*433 (245)	19.1	*315 (220)	13.5	371 (239)	16.2
Total fat (g)	*8.4 (6.9)	16.0	*6.0 (4.1)	16.7	7.1 (4.9)	16.3
Carbohydrate (g)	*91.3 (53.4)	21.4	*67.9 (48.4)	16.2	78.9 (51.7)	18.6
Protein (g)	*5.4 (5.0)	12.2	*4.2 (3.9)	9.8	4.8 (4.5)	10.9

Percent (%) contribution = nutrient intake from ultra-processed foods / Total nutrient intake; *Significant difference in mean intake between middle- and low-income adolescents ($P < 0.001$).

WHAT THIS STUDY ADDS?

- Adolescents from middle-income families consumed significantly higher amount of energy, fat, carbohydrate and protein coming from ultra-processed foods, as compared to those from low-income families.

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Web Table I Intake of Ultra-processed Foods in Adolescents From Low- and Middle-income Families

Food Items	Middle-Income group (n=475)		Low-Income group (n=555)		P value
	Frequent consumers, n (%)	Intake, g or mL	Frequent consumers n (%)	Intake, g or mL	
<i>Preserves and accompaniment*</i>					
Jam/Marmalade	190 (40)	*20.7 (10-33.3)	212 (38)	*20.4 (12-33.3)	0.88
Sauce/chutney	114 (24)	8.6 (2.4)	90 (16)	7.2 (3.3)	<0.01
<i>Confectioneries</i>					
Candies	67 (14)	*4.6 (1.3-4.6)	54 (10)	*4.2 (1.3-8)	0.02
Chocolate	18 (4)	16.7 (9.2)	12 (2)	15.5 (3.9)	0.68
<i>Bakery products</i>					
Biscuit	314 (66)	32.7 (13.4)	305 (55)	28.3 (15.1)	<0.01
Cake/pastries	40 (8)	23.5 (2.3)	0	0	-
Breads	252 (53)	56.2 (14.1)	216 (39)	55.1 (16.7)	0.54
<i>Beverage concentrate</i>					
Syrup/sherbet	185 (39)	49.9 (25.5)	164 (30)	45.3 (20.7)	0.07
Squash	49 (10)	75 (0)	0	-	-
<i>RTS beverages</i>					
Carbonated beverage	229 (48)	224.8 (85.9)	207 (37)	175.9 (51.8)	<0.01
Non-carbonated fruit beverage	66 (14)	193.9 (61.4)	48 (9)	127.7 (54.3)	<0.01
Fruit juice	17 (4)	169.8 (83.3)	0	0	-
Milk based beverage	5 (1)	60 (0)	0	0	-
<i>Miscellaneous food items</i>					
Breakfast cereals	77 (16)	42.1 (20.1)	28 (5)	30.9 (2.9)	<0.01
Sweetmeats	40 (8)	36.5 (12.1)	8 (1)	25.6 (8.3)	<0.01
Ice cream	59 (12)	37.5 (16.2)	109 (20)	16.7 (5.7)	<0.01
Savories (chips/namkeens)	35 (7)	18.7 (5)	30 (5)	17.5 (6)	0.43
Noodles/pasta	15 (3)	30.8 (12.9)	20 (4)	22.2 (11.5)	0.01

*Intake in mean (SD) except *median (IQR); Intake of solid and semi-solid foods in grams (g) and beverage concentrates and RTS beverages in milliliters (mL); RTS: Ready to serve beverages; frozen vegetarian snacks and packaged meat products were consumed by 5 children each in only in middle income group and the median (IQR) intake was 10 (9,10) and 7 (6,7).*