Public Health Nutrition: 19(15), 2799–2807 doi:10.1017/S1368980016001087

Going global: Indian adolescents' eating patterns

Nida I Shaikh[1,*], Shailaja S Patil[2], Shiva Halli[3], Usha Ramakrishnan[1,4] and Solveig A Cunningham[1,4,5]

[1]Doctoral Program in Nutrition and Health Sciences, Laney Graduate School, Emory University, 1518 Clifton Road NE, 7040-J, Atlanta, GA 30322, USA: [2]Department of Community Medicine, Shri B.M. Patil Medical College, Hospital & Research Center, BLDE University, Vijayapura, Karnataka, India: [3]Department of Community Health Sciences, University of Manitoba, Winnipeg, Manitoba, Canada: [4]Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA: [5]Department of Sociology, Emory University, Atlanta, GA, USA

Submitted 15 July 2015: Final revision received 15 March 2016: Accepted 11 April 2016: First published online 12 May 2016

Abstract

Objective: To describe adolescents' eating patterns of traditional, global/non-local and mixed foods, and the factors that may influence food consumption, access and preferences, in a globalizing city.

Design: A representative sample of school-going adolescents completed a cross-sectional survey including an FFQ designed to identify traditional and global foods. Student's *t* test and ordinal logistic regression were used to examine weekly food intake, including differences between boys and girls and between adolescents attending private and public schools.

Setting: Vijayapura city, Karnataka State, India.

Subjects: Adolescents (*n* 399) aged 13–16 years.

Results: Compared with dietary guidelines, adolescents consumed fruit, green leafy vegetables, non-green leafy vegetables and dairy less frequently than recommended and consumed energy-dense foods more frequently than recommended. Traditional but expensive foods (fruits, dairy, homemade sweets and added fat) were more frequently consumed by private-school students, generally from wealthier, more connected families, than by public-school students; the latter more frequently consumed both traditional (tea, coffee, eggs) and mixed foods (snack and street foods; $P \leq 0{\cdot}05$). Girls reported more frequent consumption of global/non-local packaged and ready-to-eat foods, non-green leafy vegetables and added fat than boys ($P \leq 0{\cdot}05$). Boys reported more frequent consumption of eggs and street foods than girls ($P \leq 0{\cdot}05$).

Conclusions: Adolescents' eating patterns in a globalizing city reflect a combination of global/non-local and traditional foods, access and preferences. As global foods continue to appear in low- and middle-income countries, understanding dietary patterns and preferences can inform efforts to promote diversity and healthfulness of foods.

Keywords
Adolescents
Food
Nutrition transition
Globalization
India

Globalization, urbanization and economic development are contributing to shifts in food accessibility and food consumption patterns in low- and middle-income countries, including India[1,2]. Urban regions in low- and middle-income countries including India[1–5], Brazil[6] and China[2] are experiencing the penetration of new foods from other countries (global) or other regions (non-local)[7]. Refined carbohydrates, snack foods, processed foods and fried foods appear to be replacing traditional foods such as unrefined whole grains, fruit, vegetables and nuts[8]. 'Nutrition transition', the term used to describe these shifts, may be implicated in increasing nutrition-related non-communicable diseases, including diabetes and obesity, in many parts of the world[9]. Global and non-local foods are also beginning to reach rural areas and poorer individuals; at the same time, nutrition-related non-communicable diseases are also increasingly prevalent not only among upper and middle socio-economic groups, as observed in the past, but also in lower socio-economic groups[10–12]. In India, 62 million adults of a population of 1·2 billion have diabetes and, by 2035, 101 million adults are expected to have diabetes[13]. About 10 % of Indians aged 0–54 years are overweight or obese[14]. Among Indian adolescents, who comprise one-fifth of the population (~243 million)[15], 37 % are underweight and 5 % are overweight or obese[14].

Adolescence is a critical life period when eating habits are established[16] and during which adequate nutrition

*Corresponding author: Email: nida.shaikh@emory.edu

promotes healthy growth and health in adulthood[17]. Adolescents are also often at the forefront of social change and global trends[18] and are experiencing increasing spending power relative to earlier generations[19]. Healthy eating can be challenging for adolescents in the context of new, trendy, palatable processed foods and fast foods appearing with globalization and promoted through peers and the media[20–22]. Eating patterns are moulded by the meeting of traditional and global factors[23], which occurs within the broader contexts of socio-economic status, urbanization and gender relations. In low- and middle-income countries, including India, urban, wealthier, more globally connected families are often the first to adopt Western foods, many of which are energy-dense (high-energy poor-nutrient) and high in sugar, saturated fat and salt[24]. Most research on the nutritional transition in India has focused on globally connected metropolitan areas[5,25,26]. In India, the type of school attended by an adolescent can be a marker of socio-economic status and connectivity. School-going adolescents from higher socio-economic families in the urban Indian cities of Bengaluru[25], Hyderabad[26] and Baroda[27] had more global foods comprising processed foods, fast foods and carbonated beverages in their diets, while rural adolescents across nine states of India had more traditional diets including grains, pulses and green leafy vegetables (GLV)[28]. Adolescents in Hyderabad preferred global fast foods (e.g. noodles and corn flakes) to traditional foods (e.g. *idli*)[26]. Those from higher socio-economic families had higher traditional food group intake including fruits, GLV and dairy products than those from lower socio-economic families[26]. The diets of adolescents in Bengaluru were higher in fat, especially saturated fats, and lesser in carbohydrates[25]. Among adolescents across social strata in Baroda and Hyderabad, half consumed carbonated beverages and over one-third consumed fast foods once or twice weekly[26,27]. We expect that, as private schools tend to have more resources[29,30] and be more globally connected, they may offer more opportunities for learning about and accessing global foods.

Furthermore, studies of child health in India have drawn attention to concerns about differences in resources provided to boys and girls[31–33]. There is persistent concern that girls tend to receive lower-quality food, less food and less expensive food, such as grains rather than milk and fat[31–33]. It is unclear whether there are gender differences in food allocation and how these may change during the nutrition transition. Lower privilege and less freedom of movement for girls may entail that they may have less access to non-local and global foods. We expect socio-economic and gender differences in access to global and non-local foods.

Data on food consumption among adolescents in India have been limited, although food availability is believed to be changing. The present study examines the nutrition transition in a community outside the global metropolitan areas, drawing on a representative study of school-going adolescents in a remote mid-size city in South India. We provide new data on adolescents' food consumption in the context of changing nutritional environments and examine differences therein by gender and socio-economic status. Given the penetration of new foods and beverages from other countries (global) and regions within India (non-local)[7] along with existing ones, we also classify foods and beverages in terms of being traditional, global/non-local or a combination of both.

Methods

Setting

Data are from a representative school-based sample of 407 adolescents aged 13–16 years and their families from a remote mid-size city in Karnataka, South India. With a population of 350 000, Vijayapura city is the main urban centre in the Vijayapura district, which is considered to be an underdeveloped district. The region is undergoing socio-economic development and urbanization through the growth of large-scale industries[34].

Three public (government-funded) and three private schools were randomly selected from schools with grades 8–12 in Vijayapura city. A stratified simple random sample of 201 public-school students (102 boys, ninety-nine girls) and 206 private-school students (105 boys, 101 girls) was drawn from school rosters. The sample size was calculated with the prevalence of unhealthy weight as the outcome, assumed at 40 %, 6 % precision, 95 % CI and a design effect of 1·5. In January–April 2012, adolescents completed a survey at school; additional information was collected from their primary caregiver during a subsequent home visit. Trained interviewers conducted interviews in the local language, Kannada, having obtained informed consent from the caregivers and assent from the adolescents. During training of the interviewers, inter-rater reliability was assessed and low discordance was reported (<10 %).

Variables

Adolescents reported demographic information and primary caregivers provided socio-economic information. A sixteen-item FFQ was developed for the study in collaboration with a trained nutritionist from Karnataka to assess adolescents' consumption of prominent traditional and global foods. The FFQ comprised key foods that are commonly consumed by adolescents. To our knowledge this is the first brief FFQ for adolescents in Vijayapura. We conceptualized foods into three categories, created based on previous literature and the authors' field observations: (i) traditional items, i.e. GLV, non-GLV, fruits, eggs, dairy,

https://doi.org/10.1017/S1368980016001087 Published online by Cambridge University Press

tea or coffee, addition of dietary fat (e.g. butter, ghee, oil) to prepared food and homemade Indian sweets; (ii) global or non-local items, i.e. carbonated beverages, packaged foods (e.g. biscuits, chips, chocolates), bakery products (e.g. bread, cakes) and ready-to-eat foods (e.g. instant noodles, packaged cereals); and (iii) mixed items, i.e. non-vegetarian foods (e.g. fish, poultry, mutton), fruit juices, Indian savoury snacks (e.g. *chaats, chooda*) and street foods (e.g. fried samosa, fried fritters). The category of 'mixed items' refers to foods that are both traditional and global or non-local, such as fruit juices, which can include 'traditional' fresh juices made at home or at a restaurant and 'global' bottled fruit juices.

Participants were asked: 'How often in a week do you eat or drink the following foods?' Response categories were 'daily', 'few times per week', 'once per week' and 'less than once per week or never'. For analysis, consumption frequencies were coded as a measure of days per week: daily = 7, few times per week = 3·5, once per week = 1 and less than once per week or never = 0. To measure exposure and access to foods and beverages, the control variables were age, family income, religion and caste. Adolescents provided their age while the primary caregiver provided information on the other control variables. Monthly family income was dichotomized as ≥INR 20 000 and <INR 20 000 ($US 1 = 51·0 Indian Rupees (INR) as of April 2012). Caste was dichotomized as general caste with Other Backward Caste (OBC), Scheduled Tribe (ST) and Scheduled Caste (SC) as the reference category. OBC, SC and ST are terms used by the Government of India to classify socially and educationally disadvantaged sections of the population. The religion variable was also dichotomized: Hindus and Jains were collapsed as the reference category while Muslims, Christians and other minorities were collapsed as the second category.

Statistical methods

The distribution of intake of each item was first examined. All food groups had a normal distribution. Student's *t* tests were used to compare weekly consumption by gender (boy, girl) and type of school attended (public, private). Ordinal logistic regression analysis was used to identify the correlates of weekly intake of each traditional, mixed and global/non-local food. All models were run separately for each food variable with less than once per week or never as the reference category. The variables included in the ordinal logistic regressions were gender, school type, age, family income, caste and religion. Given our hypothesis, we first ran unadjusted ordinal logistic regression models with each food variable as the primary outcome (dependent variable) and gender and school type as the main predictor variables (independent variable; model 1). In the next step of the analysis, we ran adjusted ordinal logistic regression models with both gender and school type as the predictor variables and controlled for age (model 2). We entered age in the model, given that food intakes and food choices may change as individuals become older. The unconfounded effect of age would thus be obtained from this equation. Extending the above model, we ran adjusted ordinal logistic regression models with both gender and school type as the predictor variables and controlled for family income in the presence of age (model 3). Family income, an indicator of socio-economic status, was entered in the model as economic resources may guide food choices[35]. Lastly, we further extended the above model; caste and religion were entered as the third-level variables (model 4) and their associations with the outcomes assessed in the presence of age and family income. Given that religion and caste are also relevant to consumption patterns in India, these were entered in the model[36,37]. To check for robustness, we also carried out multivariate linear regression analysis of the predictors of weekly intake of traditional, mixed and global/non-local foods and beverages. As an additional analysis, the intake frequencies of fruit, GLV, non-GLV and dairy were compared with those recommended under the Dietary Guidelines of India[38].

Eight adolescents were excluded from the analyses: the caregivers of five adolescents did not know or refused to respond to questions about monthly family income and three adolescents could not be interviewed after the initial selection. The final analytic sample was 399 participants. To generate population-representative results of school-going adolescents in Vijayapura, survey weights were constructed to adjust for survey design as the inverse of the probability of selection. Data were analysed using the statistical software package SAS version 9.2.

Results

Demographic and socio-economic characteristics

Adolescents in grades 8–12 were on average 14 years old; 53 % were boys, 80 % ascribed to the Hindu religion, 53 % were classified as OBC and 72 % attended public schools in Vijayapura (Table 1). The majority of adolescents lived in permanent structure (*pucca*) homes (78 %) with a separate room for cooking (86 %) and used gas or electricity for cooking (80 %). The largest number were from families in the second poorest income group (32·5 %) with a monthly income of INR 5001–10 000 ($US 98–196 as of April 2012).

Food consumption patterns

Overall, the foods and beverages that were most frequently consumed by the adolescents were tea or coffee (5·5 d/week), dairy (5·0 d/week), packaged foods (4·8 d/week) and non-GLV (4·7 d/week) and the least frequently consumed foods and beverages (≤1·0 d/week)

https://doi.org/10.1017/S1368980016001087 Published online by Cambridge University Press

Table 1 Demographic and socio-economic profile of school-going adolescents aged 13–16 years in Vijayapura, India (*n* 399)

	Overall		Public school		Private school	
Characteristic†	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Age (years)‡	14·3	14·3, 14·5	14·4	14·3, 14·6	14·2*	14·1, 14·3
Boys	53·4	48·0, 58·7	51·8	44·9, 58·7	57·7	50·7, 64·3
Religion						
Hindu	79·5	74·8, 83·5	80·2	74·1, 85·2	77·5	71·0, 82·9
Muslim	17·3	13·6, 21·8	17·4	12·7, 23·3	17·2	12·5, 23·3
Others	3·2	1·9, 5·5	2·4	1·0, 5·7	5·3	2·9, 9·4
Caste						
General	25·3	20·9, 30·3	25·9	20·3, 32·4	23·8	18·3, 30·3
Other Backward Caste	53·1	47·7, 58·4	50·7	43·8, 57·6	59·3	52·2, 66·0
Scheduled Caste and Scheduled Tribe	21·6	17·4, 26·9	23·4	18·1, 29·8	16·9	12·2, 22·9
Monthly family income (INR) ($US)§						
<5000 (< $US 98)	15·2	11·6, 19·5	15·9	11·5, 21·7	13·2*	9·0, 19·0
5001–10 000 ($US 98–196)	32·5	27·6, 37·7	34·3	28·0, 41·1	27·8	22·0, 34·5
10 001–20 000 ($US 196–392)	25·6	21·2, 30·6	25·9	20·4, 32·5	24·7	19·1, 31·3
≥20 000 (≥$US 392)	26·7	22·3, 31·7	23·9	18·4, 30·3	34·3	27·9, 41·2
Size of family‡	5·3	5·0, 5·4	5·0	4·7, 5·3	5·6*	5·2, 6·0
Type of house						
Permanent structure (*pucca*)	78·4	73·6, 82·5	78·6	72·3, 83·7	78·0	71·5, 83·4
Non-permanent structure *(semi-pucca* & *kaccha)*‖	21·6	17·4, 26·4	21·4	16·3, 27·7	22·0	16·6, 28·5
Separate room for cooking						
Yes	86·3	82·1, 89·7	85·1	79·4, 89·4	89·7	84·5, 93·3
No	13·7	10·3, 17·9	14·9	10·6, 20·6	10·3	6·7, 15·5
Type of fuel used in family for cooking						
Gas/LPG, electricity	80·2	75·6, 84·1	81·5	75·4, 86·3	76·8	70·3, 82·2
Wood, kerosene	19·8	15·9, 24·4	18·5	13·7, 24·5	23·2	17·8, 29·7

LPG, liquid petroleum gas.
Data were collected in January-April 2012.
*$P < 0·05$.
†Data are presented as percentage and 95 % CI unless indicated otherwise.
‡Continuous variables are presented as mean and 95 % CI.
§$US 1 = 51·0 Indian Rupees (INR), April 2012.
‖*Kaccha* house is a makeshift one wherein the roof and walls are made of mud or dried brick (organic materials). *Semi-pucca* house is also not a permanent structure house, it lack columns and beams but is built with some cement.

were homemade sweets, ready-to-eat foods, non-vegetarian foods, fruit juices and carbonated beverages. Compared with the Dietary Guidelines of India, adolescents consumed fruit 51·4 %, GLV 45·7 %, non-GLV 32·9 % and dairy 28·6 % less frequently and energy-dense foods more frequently than recommended.

The weekly consumption (d/week) of traditional, mixed and global/non-local foods and beverages by adolescents is given in Table 2. Among the traditional foods and beverages, the more expensive ones, including fruit (5·0 *v.* 2·7 d/week; 58 % *v.* 18 % daily), dairy (5·7 *v.* 4·7 d/week; 85 % *v.* 74 % daily or several times per week), homemade sweets (1·1 *v.* 0·4 d/week, 20 % *v.* 5·5 % daily or several times per week) and fat added to prepared food (3·8 *v.* 2·0 d/week, 44 % *v.* 21 % daily), were more frequently consumed by private-school students than by public-school students. The relatively less expensive traditional foods including tea or coffee (5·9 *v.* 4·4 d/week) and eggs (2·0 *v.* 1·0 d/week) were more frequently consumed by public-school students than by private-school students. Girls reported significantly more frequent consumption of non-GLV (5·0 *v.* 4·3 d/week) and fat added to prepared food (3·0 *v.* 2·1 d/week) than boys. Boys reported more frequent consumption of eggs (2·0 *v.* 1·5 d/week; 42 % *v.* 29 % daily) than girls.

Among the mixed foods and beverages, public-school students had significantly higher consumption of snack foods (1·5 *v.* 0·8 d/week), street foods (1·3 *v.* 0·8 d/week) and non-vegetarian foods (0·8 *v.* 0·2 d/week) than private-school students, who had a significantly higher consumption of fruit juices (1·3 *v.* 0·8 d/week; 25 % *v.* 13 % daily). Boys reported significantly more frequent consumption of street foods (1·5 *v.* 0·9 d/week; 28 % *v.* 15 % few times per week) than girls. With regard to the global/non-local foods and beverages, public-school students had a significantly higher consumption of carbonated beverages (1·1 *v.* 0·4 d/week) compared with private-school students and girls reported a significantly more frequent consumption of energy-dense packaged global/non-local foods (5·1 *v.* 4·5 d/week) and ready-to-eat foods (1·5 *v.* 0·8 d/week) than boys.

Differences in consumption of traditional, mixed and global/non-local foods between private- and public-school students and between boys and girls were robust to controlling for age, income, caste and religion (Table 3). Among traditional foods, non-GLV (OR = 0·55; 95 % CI 0·38, 0·81) were less likely to be consumed by boys than girls. Boys were also less likely to add fat to food (OR = 0·49; 95 % CI 0·33, 0·71) than girls. Fruit (OR = 5·46; 95 % CI 3·50, 8·52), dairy (OR = 2·30; 95 % CI 1·41, 3·75),

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Table 2 Weekly consumption (d/week) of traditional, mixed and global/non-local foods and beverages among school-going adolescents aged 13–16 years in Vijayapura, India (*n* 399)

	Consumption (d/week)†									
	Overall		Public school (*n* 201)		Private school (*n* 198)		Boys (*n* 200)		Girls (*n* 199)	
Food/beverage item	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Traditional										
GLV	3·8	3·5, 4·0	3·8	3·5, 4·1	3·8	3·4, 4·0	3·8	3·5, 4·1	3·8	3·4, 4·1
Non-GLV	4·7	4·4, 4·9	4·6	4·3, 4·9	4·9	4·6, 5·2	4·3	4·0, 4·7	5·0**	4·7, 5·3
Fruit	3·4	3·1, 3·6	2·7	2·4, 3·1	5·0***	4·7, 5·4	3·3	2·9, 3·6	3·5	3·1, 3·8
Eggs	1·8	1·6, 2·0	2·0	1·7, 2·3	1·0***	0·8, 1·2	2·0	1·7, 2·3	1·5*	1·2, 1·7
Dairy‡	5·0	4·7, 5·3	4·7	4·3, 5·1	5·7**	5·3, 6·0	5·0	4·6, 5·4	4·9	4·5, 5·3
Homemade Indian sweets	0·6	0·5, 0·7	0·4	0·3, 0·6	1·1***	0·8, 1·3	0·7	0·5, 0·8	0·6	0·4, 0·7
Extra fat added to prepared food§	2·5	2·2, 2·8	2·0	1·7, 2·4	3·8***	3·4, 4·2	2·1	1·7, 2·5	3·0**	2·6, 3·4
Tea or coffee	5·5	5·2, 5·7	5·9	5·5, 6·2	4·4***	3·9, 4·8	5·4	5·0, 5·8	5·5	5·1, 5·9
Mixed										
Fruit juices	1·0	0·8, 1·1	0·8	0·6, 1·0	1·3**	1·1, 1·5	1·0	0·8, 1·2	0·9	0·7, 1·1
Indian snacks‖	1·3	1·1, 1·5	1·5	1·2, 1·8	0·8**	0·6, 0·9	1·2	1·0, 1·5	1·4	1·0, 1·7
Street foods¶	1·2	1·0, 1·4	1·3	1·1, 1·6	0·8*	0·6, 1·0	1·5	1·2, 1·8	0·9**	0·7, 1·1
Non-vegetarian foods††	0·6	0·5, 0·7	0·8	0·6, 0·9	0·2***	0·1, 0·3	0·7	0·5, 0·9	0·5	0·4, 0·7
Global/non-local										
Carbonated beverages	0·9	0·7, 1·1	1·1	0·8, 1·3	0·4**	0·3, 0·5	0·9	0·7, 1·2	0·9	0·6, 1·1
Packaged foods‡‡	4·8	4·5, 5·0	4·9	4·5, 5·3	4·6	4·2, 4·9	4·5	4·1, 4·9	5·1*	4·8, 5·5
Bakery products§§	2·5	2·2, 2·7	2·6	2·2, 3·0	2·2	1·9, 2·5	2·5	2·1, 2·9	2·4	2·1, 2·8
Ready-to-eat foods‖‖	1·2	1·0, 1·3	1·1	0·9, 1·4	1·3	1·1, 1·6	0·8	0·6, 1·1	1·5**	1·2, 1·8

GLV, green leafy vegetables.
Data were collected in January–April 2012. Results are survey-adjusted. Differences in food consumption between private- and public-school students and between boys and girls were tested using *t* tests.
*$P < 0·05$, **$P < 0·01$, ***$P < 0·001$.
†Weekly food consumption values are presented as mean and 95 % CI.
‡Dairy includes milk and milk products.
§'Extra fat added to prepared food' includes butter, ghee and oil added to prepared food.
‖Indian snacks include *chaats*, *chooda*, etc.
¶Street foods include samosa, *kachori*, etc.
††Non-vegetarian foods include fish, poultry and mutton.
‡‡Packaged foods include biscuits, chips and chocolates.
§§Bakery products include bread, sandwiches, pizza, burgers and cakes.
‖‖Ready-to-eat foods include instant noodles, cereals, etc.

added fat (OR = 3·25; 95 % CI 2·13, 4·97) and homemade sweets (OR = 2·57; 95 % CI 1·64, 4·01) were more likely to be consumed by those attending private schools than public schools. Alternatively, tea or coffee (OR = 0·28; 95 % CI 0·17, 0·46) was more likely to be consumed by those attending public schools than private schools. Eggs were more likely to be frequently consumed by boys (OR = 2·03; 95 % CI 1·39, 2·95), public-school students (OR = 0·32; 95 % CI 0·21, 0·49) and younger adolescents (OR = 0·81; 95 % CI 0·67, 0·98) than by girls, private-school students and older adolescents, respectively.

With regard to the mixed foods, street foods (OR = 1·88; 95 % CI 1·28, 2·76) were more likely to be frequently consumed by boys than girls. Non-vegetarian foods (OR = 0·20; 95 % CI 0·11, 0·36) and Indian snacks (OR = 0·64; 95 % CI 0·42, 0·99) were more likely to be consumed and fruit juice (OR = 2·12; 95 % CI 1·39, 3·24) was less likely to be consumed by public-schools adolescents than by private-school adolescents. Among global and non-local foods, ready-to-eat foods were more likely to be consumed by private-school adolescents (OR = 1·98; 95 % CI 1·29, 3·03), girls (OR = 0·46; 95 % CI 0·31, 0·68) and younger adolescents (OR = 0·71; 95 % CI 0·58, 0·87) than by public-school adolescents, boys and older adolescents, respectively. Private-school adolescents (OR = 0·54; 95 % CI 0·33, 0·87) and those belonging to the general caste (OR = 0·59; 95 % CI 0·35, 0·97) were less likely to consume carbonated beverages than were public-school adolescents and those belonging to OBC, ST and SC, respectively. Boys (OR = 0·63; 95 % CI 0·43, 0·92) and adolescents in higher-income households were less likely to frequently consume packaged foods (OR = 0·62; 95 % CI 0·41, 0·96) than girls and those in lower-income households, respectively. Results are consistent using multivariate linear regression (see online supplementary material, Supplemental Table 1).

Discussion

With urbanization and globalization, the access to, preferences for and consumption of foods and beverages may be changing in low- and middle-income countries. The present study investigated adolescents' consumption patterns in a remote mid-size city in South India and contextualized foods and beverages in three main categories: traditional foods, mixed foods and global/non-local foods. Overall, compared with dietary

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Table 3 Intakes of traditional, mixed and global/non-local foods and beverages (d/week) among adolescents aged 13–16 years in Vijayapura, India (*n* 399). OR ratios and 95 % CI from ordered logistic regression models

	Traditional foods															
	GLV		Non-GLV		Fruit		Egg		Dairy		Added fat		Homemade sweets		Tea/coffee	
Variable	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Gender (ref. = Girl)																
Boy	1·04	0·72, 1·50	0·55**	0·38, 0·81	0·88	0·61, 1·27	2·03**	1·39, 2·95	1·02	0·68, 1·53	0·49**	0·33, 0·71	1·05	0·69, 1·59	1·11	0·69, 1·79
School type (ref. = Public school)																
Private	0·99	0·66, 1·50	1·30	0·84, 1·99	5·46***	3·50, 8·52	0·32***	0·21, 0·49	2·30**	1·41, 3·75	3·25***	2·13, 4·97	2·57***	1·64, 4·01	0·28***	0·17, 0·46
Age (years)	0·96	0·79, 1·15	0·93	0·77, 1·12	0·89	0·74, 1·08	0·81*	0·67, 0·98	1·07	0·87, 1·31	1·07	0·89, 1·30	0·96	0·78, 1·19	0·79	0·62, 1·01
Monthly family income (ref. = <INR 20 000)†																
≥INR 20 000	0·96	0·65, 1·51	1·26	0·82, 1·96	1·33	0·87, 2·03	0·88	0·58, 1·34	0·90	0·57, 1·42	1·04	0·68, 1·60	0·93	0·57, 1·49	1·30	0·75, 2·27
Caste (ref. = OBC and SC and ST)																
General	0·99	0·64, 1·52	1·32	0·84, 2·07	1·37	0·89, 2·13	1·21	0·78, 1·86	1·12	0·69, 1·80	0·79	0·50, 1·23	0·97	0·59, 1·58	0·97	0·56, 1·70
Religion (ref. = Hindu)																
Muslim and others	0·79	0·50, 1·25	0·77	0·48, 1·24	0·81	0·51, 1·29	0·90	0·56, 1·43	0·70	0·43, 1·15	1·16	0·72, 1·85	0·79	0·46, 1·35	1·14	0·62, 2·09

	Mixed foods								Global/non-local foods							
	Non-vegetarian foods		Indian snacks		Street foods		Fruit juices		Carbonated beverages		Packaged foods		Bakery products		Ready-to-eat foods	
Variable	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Gender (ref. = Girl)																
Boy	1·34	0·88, 2·04	1·13	0·77, 1·64	1·88**	1·28, 2·76	1·06	0·72, 1·57	1·03	0·69, 1·56	0·63*	0·43, 0·92	1·04	0·71, 1·50	0·46**	0·31, 0·68
School type (ref. = Public school)																
Private school	0·20***	0·11, 0·36	0·64**	0·42, 0·99	0·70	0·46, 1·09	2·12***	1·39, 3·24	0·54**	0·33, 0·87	0·80	0·53, 1·23	0·86	0·58, 1·29	1·98**	1·29, 3·03
Age (years)	0·93	0·75, 1·14	0·94	0·78, 1·14	1·13	0·94, 1·37	0·81*	0·67, 0·99	0·92	0·75, 1·13	0·92	0·75, 1·11	0·95	0·80, 1·14	0·71**	0·58, 0·87
Monthly family income (ref. = <INR 20 000)†																
≥INR 20 000	1·03	0·64, 1·66	1·13	0·52, 1·23	1·13	0·73, 1·74	1·03	0·66, 1·60	0·98	0·61, 1·57	0·62*	0·41, 0·96	0·94	0·62, 1·41	1·24	0·80, 1·92
Caste (ref. = OBC and SC and ST)																
General	1·11	0·68, 1·80	0·81	0·52, 1·23	0·64	0·41, 1·01	1·01	0·64, 1·60	0·59*	0·35, 0·97	1·12	0·71, 1·75	1·27	0·83, 1·93	1·17	0·74, 1·84
Religion (ref. = Hindu)																
Muslim and others	1·44	0·86, 2·42	0·90	0·56, 1·44	1·22	0·76, 1·95	0·95	0·58, 1·56	0·90	0·54, 1·50	1·43*	0·87, 2·35	0·97	0·62, 1·52	1·21	0·74, 1·98

GLV, green leafy vegetables; ref., reference category; OBC, Other Backward Caste; ST, Scheduled Tribe; SC, Scheduled Caste.
Data were collected in January–April 2012. Results are survey-adjusted.
*$P < 0·05$, **$P < 0·01$, ***$P < 0·001$.
†$US 1 = 51·0 Indian Rupees (INR), April 2012. Family income was asked over a month.

guidelines, adolescents consumed energy-dense foods more frequently than recommended and consumed fruit, GLV, non-GLV and dairy less frequently than recommended[38]. Adolescents' exposure to global, non-local and traditional foods is showing resemblance to levels reported in urban areas. Still, dietary quality seems to be better in this remote mid-sized city than in Indian metropoles, with moderate intakes of GLV, fruits and dairy (~3·5–4 d/week) and low intake of homemade sweets (~0·6–2 d/week)[26,27,39].

The Dietary Guidelines of India recommend daily intake of GLV and fruits[38] while the WHO recommends a daily intake of 400 g of fruits and vegetables to prevent chronic diseases and micronutrient deficiencies[40]. In our study, only 29 % ate GLV and fruits daily while 10 % did so less than once monthly or not at all. A study in two Indian cities showed that all adolescents aged 12–14 years consumed GLV at least once weekly and those in the higher socio-economic group consumed GLV almost daily[26], so our population may be better off. Studies worldwide, including in India, have reported low fruit and vegetable intakes among adolescents from low-income households[26,41]. Data from across thirty-five countries indicated that adolescents ate fruit on average 2·8–5·0 d/week, vegetables 2·4–5·5 d/week and sweets 2·6–5·0 d/week[42]. In comparison, Vijayapura adolescents had less frequent consumption of fruit (0·8 to 6 d/week) and sweets (0·6 to 1·8 d/week) but similar frequency of GLV (1·5 to 6·2 d/week) and non-GLV (2·4 to 7·0 d/week). The majority of adolescents (91 %) in our study consumed homemade sweets less than once weekly, contrary to recent reports of increasing consumption of sweets among children and adolescents in Asia[39,43]. The infrequent weekly intake of homemade sweets may be due to their high cost and the traditional practice of making them mainly during festivals or special family occasions such as weddings.

In our study, the more frequent consumption of processed global/non-local foods among public-school students than among private-school students may be explained by the availability of low-cost versions of branded processed foods, produced to cater to low-income groups and to fit local tastes[22]. These unregulated cheaper and often lower-quality foods could worsen nutritionally poor diets[22]. Our findings align with reports from urban areas that biscuits and salted snacks are being eaten more over the past two decades and that low-cost fried and processed foods are a key feature of the nutrition transition in India[4,44,45]. Frequent consumption of processed foods has been reported to be associated with nutrition-related non-communicable diseases among adolescents[22,45,46]. Contrary to reports of increasing consumption of carbonated beverages documented among adolescents in Asia in the past few decades[39,43], the majority of adolescents (85 %) in our study consumed carbonated beverages less than once weekly. The low consumption of carbonated beverages may be due to their relatively higher cost (e.g. 200 ml Pepsi at INR 8 and 500 ml Pepsi at INR 20) when compared with the ready availability of cheaper alternatives for ≤INR 5 such as juice on street carts, ice candy, biscuit, chips, etc. that adolescents could purchase.

Food prices in relation to family income can affect a family's purchasing decisions. In our study, traditional but expensive foods including fruits, dairy, added fat and homemade sweets were more frequently consumed by private- than public-school adolescents. The National Family Health Surveys (NFHS 2)[47] and a study in Hyderabad, India[48] both reported higher intakes of milk and fruits among children of higher income groups. In our study, 41 % of adolescents attending public schools but only 22 % of those attending private schools consumed eggs daily or a few times weekly. Eggs (raw and boiled) are sold mainly on street carts placed outside centrally located public schools and markets in the city for INR 5–6 ($US 0.07–0.09) each (as of April 2012) that make them accessible to public-school students. The intake of eggs may be also be driven by religion or caste. Although eggs are often not consumed by some religious groups (e.g. Jains)[36], we did not find significant differences in egg intake by religion or caste. Adolescents drank tea and coffee frequently (~5 d/week), with 82 % of public-school adolescents and 60 % of private-school adolescents consuming daily. Only 63 % of adolescents consumed dairy daily and 22 % had dairy less than once weekly. Drinking tea or coffee cooked with milk does not provide the same nutritional benefits as consuming milk, known to be rich in protein and calcium. Drinking tea or coffee instead of milk is likely a result of cultural norms and the high cost of milk (INR 30–40 per litre as of April 2012), which could explain higher tea or coffee intake by public- than private-school adolescents.

In addition to food prices, religion, caste and gender norms are also relevant to consumption patterns in India. For the majority of people in India, particularly those of Hindu religion, food habits are driven by religious vegetarianism[36,37]. With increasing incomes, studies have reported increased intake of animal-source foods[3,49]. In addition, for much of history, people may have liked to eat non-vegetarian foods but were effectively vegetarian because of lack of access. In our study, public-school adolescents more frequently consumed non-vegetarian foods, Indian snacks and street foods compared with private-school adolescents after accounting for age, gender, caste and religion. More frequent intake of non-vegetarian foods among public- than private-school adolescents in our study, as also reported in Hyderabad[26], could be an indicator of changing food access and norms reflecting globalizing diets. More frequent egg and street food consumption by boys may be a result of gender and cultural norms that allow boys more access to foods believed to be strength-building, like eggs and meat, and

to be away from home or outdoors more than girls. The cultural norms and religious taboos around eating eggs and meat may also be a barrier for girls more than for boys.

Our study has some limitations. Dietary assessment methods, including FFQ, may be limited by children's inadequate knowledge of and difficulty in estimating the foods they consume[50]. Still, by age 8–10 years, children can report their food intake as reliably as their parents[50]. Furthermore, minimal food recall difficulty is expected, as a weekly, not monthly or yearly, FFQ was used. There may be gender differences in perceiving or reporting food consumption. For example, boys may under-report adding fat to food because cultural norms have mothers in traditional Indian households typically serving children's food. Mothers would add extra fat to food while serving but may also follow this practice more so for boys than girls. More frequently adding fat to food among girls than boys could also be explained by the belief that consuming ghee will help girls build strength to sustain future childbirth. Another consideration is that our FFQ used only sixteen food groups and did not explicitly ask about some major food groups such as pulses and grains. The FFQ was designed to capture prominent traditional and global foods, and so was well suited to address the research topic of the study.

The current study presents several strengths and contributions. While many studies from India have focused on urban areas, our research was in a prototype remote city that is traditionally underdeveloped but undergoing urbanization and experiencing new exposure to non-local and global trends. This setting is particularly well suited to investigate adolescents' dietary patterns in a globalizing context. Our sample was representative of school-going adolescents from across the socio-economic spectrum in this setting. We have also proposed a way of categorizing foods and beverages as traditional, mixed and global/non-local that contextualizes the components of a diet in terms of the nutrition transition. Lastly, our study quantified differences in consumption according to gender, school type attended, and access to foods and beverages.

Conclusions

Adolescents' eating patterns in a globalizing Indian city reflect a combination of global/non-local and traditional foods, access and preferences. Adolescents' exposure to global, non-local and traditional foods is beginning to mirror urban levels reported in more metropolitan areas. Girls reported more frequent consumption of energy-dense traditional, mixed, and global or non-local foods and boys reported more frequent consumption of eggs and street foods. As global and non-local foods continue to emerge but have not yet overwhelmed the local culture in rural and urbanizing communities in low- and middle-income countries, it may be possible to intervene at this stage to promote healthy eating behaviours among the youth. An important direction for future research will be to understand emerging dietary patterns and preferences that can inform efforts to promote dietary diversity and healthful food consumption.

Acknowledgements

Acknowledgements: The authors thank Dr M.C. Yadavannavar at BLDE University for his assistance with data collection, Dr Veena Algur for her assistance with translation of study materials, and the adolescents and their families for participation in this study. *Financial support*: The study described was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development (award number 3D43HD065249-03S1). N.S. was supported by the Fogarty International Center at the National Institutes of Health (award number 1-R25 TW009337-01). The Eunice Kennedy Shriver National Institute of Child Health & Human Development had no role in the design, analysis or writing of this article. *Disclosure*: The content is solely the responsibility of the authors and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health & Human Development. *Conflict of interest*: None. *Authorship*: N.I.S. and S.A.C. formulated the research question; N.I.S., S.H., S.S.P. and S.A.C. designed the study; S.S.P. and S.A.C. carried it out; N.I.S. analysed the data, with interpretative input from all authors; N.I.S. drafted the manuscript; all authors helped to revise the manuscript and approved the final version. *Ethics of human subject participation*: The Institutional Ethical Committees at BLDE University, Vijayapura and at the Center for Chronic Disease Control, New Delhi approved the study and the Institutional Review Board at Emory University, Atlanta, GA approved the secondary data analysis.

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016001087

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