Original Article

Consumption of highly processed snacks, sugar-sweetened beverages and child feeding practices in a rural area of Nicaragua

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Abstract

Appropriate feeding behaviours are important for child growth and development. In societies undergoing nutrition transition, new food items are introduced that may be unfavourable for child health. Set in rural Nicaragua, the aim of this study was to describe the infant and young child feeding (IYCF) practices as well as the consumption of highly processed snack foods (HP snacks) and sugar-sweetened beverages (SSBs). All households with at least one child 0- to 35-month-old ($n = 1371$) were visited to collect information on current IYCF practices in the youngest child as well as consumption of SSBs and HP snacks. Breastfeeding was dominant (98%) among 0- to 1-month-olds and continued to be prevalent (60%) in the second year, while only 34% of the 0- to 5-month-olds were exclusively breastfed. Complementary feeding practices were deemed acceptable for only 59% of the 6- to 11-month-old infants, with low dietary diversity reported for 50% and inadequate meal frequency reported for 30%. Consumption of HP snacks and SSBs was frequent and started early; among 6- to 8-month-olds, 42% and 32% had consumed HP snacks and SSBs, respectively. The difference between the observed IYCF behaviours and World Health Organization recommendations raises concern of increased risk of infections and insufficient intake of micronutrients that may impair linear growth. The concurrent high consumption of SSBs and HP snacks may increase the risk of displacing the recommended feeding behaviours. To promote immediate and long-term health, growth and development, there is a need to both promote recommended IYCF practices as well as discourage unfavourable feeding behaviours.

Keywords: breastfeeding, complementary feeding, dietary diversity, meal frequency, Nicaragua, snacking.

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Introduction

Childhood undernutrition remains a major underlying contributor to the global burden of under-5 mortality and disease (Black *et al.* 2008, 2013). To respond to this problem, optimal infant and young child feeding (IYCF) practices have been described and are recognised as key factors for the prevention of undernutrition during the first years of life. Indicators for IYCF practices have also been developed and

used to monitor the progress in IYCF worldwide (WHO 2008). These indicators focus on critical aspects of appropriate feeding that can be measured in large-scale surveys, such as exclusive breastfeeding for the first 6 months as well as dietary diversity and meal frequency representing some dimensions of complementary feeding.

Recent estimations of IYCF practices in Africa, Asia and Latin America reveal that implementation of the World Health Organization (WHO)

recommendations remains poor. Globally, only 36% of infants aged 0 to 5 months are exclusively breastfed and among 4- to 5-month-old infants this is further reduced to only 18% (Lutter *et al.* 2011). While breastfeeding commonly continues beyond 6 months, children's complementary diet shows considerable regional variation; particularly in achieving at least the minimum level of dietary diversity, with prevalence of adequate dietary diversity reportedly being lowest (about 30%) in Asia and Africa but higher (about 70%) in Latin America (Lutter *et al.* 2011).

IYCF guidelines (and their indicators for assessment) focus on appropriate feeding practices critical to the prevention of undernutrition. However, in addition to undernutrition and micronutrient deficiencies, overnutrition may be present, giving rise to the double burden of malnutrition. Many populations are experiencing a nutrition transition (Popkin *et al.* 2012) with increasing consumption of processed foods and beverages high in fats and sugars or salt. The consumption of these processed foods and beverages could be one of the contributing factors to overnutrition (Monasta *et al.* 2010). Overnutrition is, in turn, a risk factor for non-communicable diseases (Lachat *et al.* 2013). Non-communicable diseases, such as cardiovascular disease, diabetes, cancer and chronic respiratory diseases, are now responsible for the largest proportion of the disease burden worldwide (Alleyne *et al.* 2013).

Reports from Central America indicate that 7% of pre-school children are overweight or obese (de Onis *et al.* 2010), suggesting an ongoing nutrition transition. At the same time, child undernutrition in terms of stunting still remains prevalent (Lutter 2012). This is also true for Nicaragua; a lower

middle-income country where almost half of the population was below the poverty line in 2005 (CEPAL 2013). Sparse information on pre-school obesity is available, and the prevalence of underweight in children was reportedly 5% in 2011–2012, while still a substantial proportion (17%) of children below 5 years of age were stunted (DHS 2013). Exclusive breastfeeding was reported in 32% of infants aged 0 to 5 months in 2011–2012 (DHS 2013). There is less information available on the consumption of highly processed snack foods and sugar-sweetened beverages (SSBs). The aim of this study, set in rural northwestern Nicaragua, was to describe IYCF practices using established feeding indicators related to the risk of undernutrition. An additional aim was to assess the consumption of high-energy-dense commercial sweet or salty crispy snack items, which we will refer to as highly processed snacks (HP snacks) and SSBs that could either displace nutrient-rich foods or be risk factors for childhood overnutrition.

Material and methods

Study setting and population

This cross-sectional study was conducted in the municipalities of Santo Tomás del Nance, San Juan de Cinco Pinos, San Pedro del Norte and San Francisco del Norte, collectively called *Los Cuatro Santos*, located in northwestern Nicaragua with a population of around 25 000 people and about 5000 households. Income generation was mostly through small-scale agriculture and a variety of non-agricultural economic activities. The Asociación para el Desarrollo Económico y Social de El Espino (APRODESE), a

Key messages

- A low prevalence of exclusive breastfeeding combined with a suboptimal complementary diet raises concern for infant and childhood stunting.
- Children's consumption of high-energy-dense snacks and SSBs were observed at an early age and may increase risks for either displacement of nutrient-rich foods or excess consumption, resulting in obesity and non-communicable diseases later in life.
- There is a need to monitor both recommended and not recommended feeding behaviours in order to evaluate risk factors for both under- and overnutrition among children in nutrition transitional societies.

local non-governmental organisation, has been executing development activities with the objective of improving people's living conditions in the area. To inform the society about recent progress in reduction of child mortality, all households in the area have also received a pamphlet containing general health messages as well as recommendations on infant feeding. In 2003, a Health and Demographic Surveillance System (HDSS) was established by APRODESE to monitor the effects of the development projects. In the HDSS rounds, information was collected on child nutrition and health, women's health and household socio-demographic characteristics. Data for our study were collected from May to November 2009, a time that coincided with the rainy season.

Study sample and data collection

A team of locally recruited interviewers visited all households (about 5000) in the area. They collected household information and identified and listed all households with at least one child younger than 3 years. These identified households were later revisited

by a second team of interviewers who collected information on IYCF practices of the youngest child in the household and on nutritional status of all children aged under 3 years (Fig. 1).

IYCF practices

IYCF was assessed by a list-based approach as described in the WHO recommended guidelines (WHO 2010). The 24-h food frequency questionnaire recalled food items consumed the day and night prior to the interview. It also included questions on breastfeeding and meal frequency (the latter phrased as number of times the child had eaten; WHO 2008). Information on food items from the Nicaraguan Demographic and Health Survey was used to develop an initial food frequency list (DHS 2008), which was adapted to the local study setting. The food frequency list included 70 food items. Furthermore, HP snacks and SSBs given to infants and children were recorded and the following seven items were included in the food frequency questionnaire because of their apparent prevalence in the study area: coffee with sugar,

Fig. 1. Flow diagram of participation in infant/young child feeding and nutrition study in Los Cuatro Santos, Nicaragua, 2009.

carbonated soft drinks, sweetened powdered fruit drinks, cookies and crackers, candies, chocolates, and salty crispy snacks. The questionnaire was pilot tested in a nearby community similar to the study area, where around 20 mothers or the primary caretaker were interviewed about breastfeeding, meal frequency and children's consumption of foods and beverages listed in the instrument.

WHO guidelines were used to construct feeding indicators on exclusive breastfeeding and continued breastfeeding (WHO 2008). Complementary feeding indicators were based on the following seven food groups: (1) grains, roots, tubers; (2) legumes and nuts; (3) vitamin A fruits and vegetables; (4) other fruits and vegetables; (5) meats; (6) eggs; and (7) dairy products (WHO 2008). Fruits and vegetables were categorised and grouped according to their vitamin A content using food composition tables (USDA 2011). One point was given to a food group when at least one of its food items was consumed the previous day. The points of the food groups were summed to give a score that ranged from 0 to 7. A cut-off of four food groups or more was defined as achieving minimum dietary diversity (WHO 2008). Further, the minimum meal frequency indicator was created from including breastfed children who had received solid, semi-solid or soft foods the minimum number of times or more and non-breastfed children who received solid, semi-solid or soft foods or milk feeds the minimum number of times or more the previous day (WHO 2008). The WHO guidelines were also used to construct an overall dietary adequacy indicator. Thus, for breastfed infants, the minimum acceptable diet includes those who had at least the minimum dietary diversity and minimum meal frequency. For non-breastfed children to reach minimum dietary adequacy, they should, in addition to these criteria, have consumed at least two milk feedings (WHO 2008). Guidelines for 6- to 23-month-old children were also applied for the age 24–35 months interval.

Statistical analyses

Intake of specific food items and feeding behaviour was presented in age-stratified categories. The occurrence of breastfeeding practices (no breastfeeding,

partial breastfeeding, predominant breastfeeding, exclusive breastfeeding) were stratified in 0–1, 2–3 and 4–5 age intervals of 0- to 5-month-olds to describe the proportion of infants who followed any of the breastfeeding practices. The proportion of infants who were breastfed within one hour after birth and the proportion of those who were exclusively breastfed were also evaluated. Due to the two-step procedure in data collection, identifying households and then a subsequent visit for collection of nutrition parameters, there was a time lag of up to 2 months. This caused us to miss households with newborn infants. To account for the disproportionately low numbers of infants in the 0–1 month age group, weighted prevalence of exclusive breastfeeding for 0–5 months has also been presented. The proportion of continued breastfeeding in the age groups 6–11, 12–23 and 24–35 months was assessed. Furthermore, the quality of complementary feeding was evaluated by the prevalence of minimum dietary diversity, minimum meal frequency and minimum acceptable diet in three age strata: 6- to 11-, 12- to 23- and 24- to 35-month-old children. In addition, intake of specific foods, including HP snack items and SSBs, were stratified into age-stratified categories 2-, 6- or 12-month age groups from 0–35 months, to describe timing of introduction to these items and prevalence of their consumption. All the analyses were performed using the Statistical Package for the Social Sciences version 20 (SPSS 2011).

Ethics

The study followed the principles of the Universal Helsinki Declaration. Mothers or the primary caretaker were informed about the study, including their right to withdraw at any time, before they were asked to give their verbal informed consent. The interviews were performed at the mother's or caretaker's household, ensuring as much privacy as possible. The study was approved by the Biomedical Research Ethics Committee at the University of León in Nicaragua. At the time of the study, the ethical review system in Sweden changed to become legislative and did not, for a period, provide ethical recommendations for research performed outside its legislative jurisdiction.

Results

A total of 1500 out of the about 5000 households had at least one child under the age of 3 years and were revisited at home by the child nutrition team (Fig. 1). Ninety-two percent of the 1500 households participated in the data collection, with 1377 mothers completing the assessment of IYCF practices relevant to their youngest child. The main reasons for missing children were that the children had not yet been listed at the first round of household visits or that they were not found at home despite up to three repeated visits. Further, children who had passed the age of eligibility at the subsequent visit were excluded from statistical analyses. A few questionnaires with missing information on key variables were also excluded, leaving 1371 youngest children in the household for the final analyses.

General characteristics

There was a high proportion of stunted children (20.2%) in the study area (Table 1). Further, overweight (8.6%) appeared to be a more common problem than underweight (5.5%). Most of the mothers were housewives, with a small percentage employed in offices, as health workers or as teachers. Less than 1% of them worked in agricultural activities (data not shown). More than two-thirds had 5 or more years of primary education and one-fifth more than 10 years of schooling. While three-quarters of the households had a latrine or toilet, only about one-fifth had access to tap water.

Breastfeeding and complementary feeding practices

Infants aged 0–5 months

Most of the infants were breastfed within 1 h after birth and 0- to 5-month-olds were commonly breastfed (Fig. 2 and Table 2). Exclusive breastfeeding was less common and practised by only about two-thirds of the mothers of 0- to 1-month-olds. Among the 2- to 3- and 4- to 5-month-olds, the prevalence of exclusive breastfeeding was 37.6% and

Table 1. Household, maternal and child characteristics in *Los Cuatro Santos*, Nicaragua, 2009

Characteristics (<i>n</i> = 1371)	% [†]	<i>n</i> /total <i>n</i> [†]
Household		
Housing quality		
Tap water	22.2	305/1371
Latrine or toilet	75.7	1037/1371
Soil/earth floor	68.1	933/1371
Adobe, ceramic or wood wall	98.0	1343/1371
Electricity	78.5	1076/1371
Home garden in use		
No	92.0	1244/1352
Maternal		
Age group (years)		
<20	12.8	175/1366
20–29	48.6	664/1366
30–39	30.7	420/1366
40+	7.8	107/1366
Formal education		
<5 years	35.8	488/1364
5–9 years	43.1	588/1364
≥10 years	21.1	288/1364
Occupation		
Teacher/health/office	5.4	73/1364
Other (student/artisan/other)	5.1	70/1364
Housewife	89.5	1221/1364
Child		
Age group (months)		
0–5	16.8	231/1371
6–11	18.2	250/1371
12–23	32.2	441/1371
24–35	32.7	449/1371
Gender		
Girls	50.8	697/1371
Nutritional status		
Underweight (WAZ < -2SD)	5.5	75/1358
Wasted (WHZ < -2SD)	4.2	56/1333
Stunted (HAZ < -2SD)	20.2	271/1342
Overweight (BAZ < -2SD)	8.6	115/1331

SD, standard deviation; WAZ, weight-for-age z-scores; WHZ, weight-for-height z-scores; HAZ, height-for-age z-scores; BAZ, BMI-for-age z-scores. [†]Values are percentages (%) and (*n*/total *n*).

13.9%, respectively (Fig. 2). For all infants aged 0–5 months, the prevalence of exclusive breastfeeding was 34% (Table 2) and 38% after weighting of the age strata (data not shown). Almost one-fourth of the 0- to 1-month-old infants had been introduced to non-human milks and were thus partially breastfed (Fig. 2 and Table 3). Partial breastfeeding was the most common feeding mode for infants aged 4–5 months.

Exclusive breastfeeding, proportion of infants who only received breast milk; predominant breastfeeding, proportion of infants who received only breast milk, water and/or water-based liquids; partial breastfeeding, proportion of infants who received breast milk, non-human milks and/or energy-containing liquids or foods.

Fig. 2. Prevalence of breastfeeding practices among 0- to-5-month-olds in Cuatro Santos, Nicaragua.

Apart from water, the earliest food items introduced were reconstituted powdered milk and formula, followed by the local staples, which are rice, corn tortillas, red beans, eggs and the local cheese (*cuajada*). Infants aged 4-5 months had also started to receive HP snack items (15%) and SSBs (11%), such as powdered fruit drinks (Table 3).

Infants and young children aged 6-11 months

Breastfeeding was still common and 88% of the 6- to 11-month-old infants were breastfed (Tables 2 and 3).

Half of the infants achieved the minimum dietary diversity of four food groups. However, when taking both meal frequency and dietary diversity into consideration, only 41% of the infants and children had a minimum acceptable diet (Table 2). The most commonly consumed food items were rice, corn tortillas, red beans, eggs and cheese, and about one-half of the infants ate any fruits or vegetables daily. However, these fruits and vegetables were not from the vitamin A-rich food group, as the most commonly eaten fruits were banana, guava and tomato. There was also a low consumption of meat products. HP snacks high in

Table 2. Percentage of infants and young children who met the WHO feeding indicators in *Los Cuatro Santos*, Nicaragua, 2009

Feeding indicators (<i>n</i> = 1371)	Age group (months)			
	0–5	6–11	12–23	24–35
	<i>n</i> = 231 % (<i>n</i> /total <i>n</i>)	<i>n</i> = 250 % (<i>n</i> /total <i>n</i>)	<i>n</i> = 441 % (<i>n</i> /total <i>n</i>)	<i>n</i> = 449 % (<i>n</i> /total <i>n</i>)
Breastfeeding				
Early initiation of breastfeeding [†]	91 (208/228)	–	–	–
Exclusive breastfeeding [‡]	34 (72/211)	–	–	–
Continued breastfeeding [§]	–	88 (213/243)	60 (262/437)	15 (66/448)
Complementary feeding				
Minimum meal frequency [¶]	–	70 (170/244)	70 (303/437)	47 (210/448)
Minimum dietary diversity ^{††}	–	50 (124/250)	69 (304/441)	74 (332/449)
Minimum acceptable diet ^{‡‡}	–	41 (101/244)	46 (201/437)	34 (152/448)

[†]Proportion of children born in the last 24 months who were put to the breast within the first hour of birth; [‡]Proportion of 0- to 5-month-olds who only received breast milk during the previous day; [§]Proportion of children 12- to 15-month-olds who received breast milk during the previous day; [¶]Based on breastfed children who received solid, semi-solid or soft foods the minimum number of times or more and non-breastfed children who received solid, semi-solid or soft foods or milk feeds the minimum number of times or more the previous day; ^{††}Criteria based on consumption of at least one food item of four of the seven food groups during the past day; ^{‡‡}Based on breastfed children who had at least the minimum dietary diversity and minimum meal frequency and non-breastfed children who received at least two milk feedings and had at least the minimum dietary diversity without milk feedings and minimum meal frequency the previous day.

sugars or salt (42%) were already consumed by the 6- to 8-month-olds (Table 3). For instance, a single portion of commonly consumed commercial cheesy corn crisps, a snack item eaten by children in our study, contained more than the maximum levels of total daily sodium requirement for 6- to 8-month-olds (Table 4). Furthermore, coffee with sugar (11%) and powdered fruit drinks (24%) were the sweetened beverages most commonly consumed among the 6- to 8-month-olds. The proportion of 6- to 11-month-olds according to different HP snack and SSB behaviour was found to be the following: no snacks (38%); SSBs, but no HP snacks (12%); HP snacks, but no SSBs (29%); and consumption of both HP snacks and SSBs (21%). Achieving minimum meal frequency was not associated with consumption of HP snacks and/or SSBs in 6- to 11-month-olds (data not shown). However, infants who met minimum dietary diversity recommendations had a higher consumption of HP snacks and/or SSBs ($P \leq 0.001$) than those who did not (data not shown).

Young children aged 12–35 months

Most of the 12- to 17-month-old children continued to be breastfed and almost one-half of the 18- to

23-month-olds were also still breastfed (Tables 2 and 3). In addition, about three-fourths reached minimum dietary diversity in the 24- to 35-month-old group. Still, due to limitations in meal frequency, only about one-third of the 24- to 35-month-olds achieved minimum acceptable diet scores. A high proportion of young children ate rice, corn tortillas and red beans, with a low proportion eating seasonal fruits such as mango or papaya. Whereas about one-half of the children consumed the local cheese (*cujada*) and eggs, only about one-third of them had consumed meat. The consumption of HP snack items was high in this age group; about two-thirds of the children had eaten at least one HP snack item the previous day. Furthermore, the intake of SSBs was also high, with more than 80% of the children having consumed one or more of coffee with sugar, a powdered fruit drink or a carbonated soft drink the day prior to the survey. We further disaggregated the proportion of 12- to 35-month-old children who consumed no HP snacks (14%); SSBs, but no HP snacks (25%); HP snacks, but no SSBs (13%); and consumption of both HP snacks and SSBs (48%). There were more children who consumed HP snacks and/or SSBs among those who achieved dietary diversity ($P \leq 0.001$), when compared with their counterparts (data not shown). No

Table 3. Proportion of infants and young children breastfed, or fed with any of the items from the food groups, selected foods or liquids, during the previous day in Los Cuatro Santos, Nicaragua, 2009

<i>n</i> = 1371	0–1 m (<i>n</i> = 53)	2–3 m (<i>n</i> = 92)	4–5 m (<i>n</i> = 86)	6–8 m (<i>n</i> = 124)	9–11 m (<i>n</i> = 126)	12–17 m (<i>n</i> = 231)	18–23 m (<i>n</i> = 210)	24–35 m (<i>n</i> = 449)
Breastfeeding [†] (<i>n</i> = 1339)	98 (46/47)	98 (83/85)	96 (76/79)	88 (105/119)	87 (108/124)	74 (168/228)	45 (94/209)	15 (66/448)
Food groups [†]								
Grains, roots, tubers [‡]								
Rice	2 (1/53)	7 (6/92)	33 (28/86)	73 (91/124)	97 (122/126)	98 (227/231)	100 (209/210)	99 (444/449)
Corn tortilla	2 (1/53)	3 (3/92)	27 (23/86)	65 (80/124)	90 (113/126)	88 (203/231)	92 (193/210)	91 (410/449)
Legumes and nuts [‡]	0 (0/53)	0 (0/92)	15 (13/86)	48 (60/124)	71 (90/126)	78 (180/231)	85 (179/210)	90 (402/449)
Red bean	0 (0/53)	0 (0/92)	23 (20/86)	59 (73/124)	85 (107/126)	91 (209/231)	93 (196/210)	96 (429/449)
Soy milk	0 (0/53)	0 (0/92)	21 (18/86)	56 (69/124)	83 (105/126)	89 (206/231)	91 (190/210)	94 (424/449)
Vit. A fruits and vegetables [‡]	0 (0/53)	0 (0/92)	4 (3/86)	7 (9/124)	2 (3/126)	6 (13/231)	8 (17/210)	8 (37/449)
Mango	0 (0/53)	0 (0/92)	5 (4/86)	15 (18/124)	19 (24/126)	23 (52/231)	24 (50/210)	25 (112/449)
Papaya	0 (0/53)	0 (0/92)	5 (4/86)	12 (15/124)	17 (21/126)	20 (46/231)	23 (49/210)	23 (103/449)
Carrot	0 (0/53)	0 (0/92)	0 (0/86)	0 (0/124)	1 (1/126)	1 (2/231)	0 (0/210)	1 (3/449)
Other fruits and vegetables [‡]	0 (0/53)	0 (0/92)	0 (0/86)	1 (1/124)	1 (1/126)	1 (3/231)	0 (0/210)	1 (6/449)
Banana	0 (0/53)	0 (0/92)	19 (16/86)	43 (53/124)	63 (79/126)	68 (157/231)	67 (140/210)	75 (335/449)
Guava (<i>n</i> = 1370)	0 (0/53)	0 (0/92)	9 (8/86)	23 (29/124)	33 (41/126)	33 (75/231)	31 (65/210)	36 (161/449)
Tomato	0 (0/53)	0 (0/92)	1 (1/86)	7 (8/124)	18 (23/126)	19 (43/231)	15 (31/209)	28 (126/449)
Meats [‡]	0 (0/53)	0 (0/92)	6 (5/86)	13 (16/124)	25 (31/126)	29 (67/231)	24 (50/210)	30 (133/449)
Beef (<i>n</i> = 1369)	0 (0/53)	0 (0/92)	6 (5/86)	21 (26/124)	33 (41/126)	32 (74/231)	29 (61/210)	38 (169/449)
Poultry (<i>n</i> = 1370)	0 (0/53)	0 (0/92)	1 (1/86)	4 (5/124)	6 (8/125)	11 (25/231)	9 (19/209)	9 (41/449)
Eggs [‡]	0 (0/53)	0 (0/92)	5 (4/86)	15 (18/124)	25 (32/126)	23 (54/231)	22 (46/210)	25 (112/448)
Chicken egg	0 (0/53)	0 (0/92)	11 (9/86)	28 (35/124)	34 (43/126)	44 (101/231)	49 (102/210)	47 (210/449)
Dairy products [‡]	9 (5/53)	19 (17/92)	37 (32/86)	61 (76/124)	60 (75/126)	64 (148/231)	61 (129/210)	68 (306/449)
Local cheese (<i>cuajada</i>)	0 (0/53)	0 (0/92)	13 (11/86)	37 (46/124)	43 (54/126)	52 (119/231)	51 (107/210)	56 (250/449)
Powdered milk	9 (5/53)	16 (15/92)	21 (18/86)	27 (34/124)	23 (29/126)	23 (52/231)	23 (49/210)	15 (67/449)
Cow milk	0 (0/53)	3 (3/92)	6 (5/86)	7 (8/124)	10 (13/126)	12 (27/231)	17 (36/210)	19 (83/449)
Liquids and formula	23 (12/53)	52 (48/92)	77 (66/86)	95 (118/124)	98 (123/126)	99 (228/231)	98 (206/210)	99 (446/449)
Formula	13 (7/53)	13 (12/92)	5 (4/86)	7 (8/124)	4 (5/126)	0 (1/231)	0 (0/210)	1 (3/449)
Water	11 (6/53)	44 (40/92)	74 (64/86)	94 (116/124)	96 (121/126)	98 (227/231)	98 (205/210)	98 (441/449)
Sugar-sweetened beverages	0 (0/53)	3 (3/92)	11 (9/86)	32 (39/124)	34 (43/126)	61 (141/231)	68 (143/210)	83 (371/449)
Coffee	0 (0/53)	1 (1/92)	4 (3/86)	11 (13/124)	16 (20/126)	38 (87/231)	51 (106/210)	69 (308/449)
Powdered fruit drink	0 (0/53)	2 (2/92)	7 (6/86)	24 (30/124)	16 (20/126)	31 (72/231)	32 (68/210)	33 (148/449)
Carbonated soft drink	0 (0/53)	0 (0/92)	1 (1/86)	2 (3/124)	9 (11/126)	12 (27/231)	10 (20/210)	17 (75/449)
Highly processed snacks	0 (0/53)	0 (0/92)	15 (13/86)	42 (52/124)	58 (73/126)	54 (132/231)	63 (132/210)	64 (287/449)
Cookies and crackers	0 (0/53)	0 (0/92)	15 (13/86)	36 (45/124)	46 (58/126)	39 (91/231)	50 (104/210)	45 (203/449)
Chocolates and candies	0 (0/53)	0 (0/92)	4 (3/86)	16 (20/124)	22 (28/126)	29 (66/231)	28 (58/210)	39 (173/449)
Salty crispy snacks	0 (0/53)	0 (0/92)	4 (3/86)	9 (11/124)	17 (21/126)	22 (50/231)	24 (50/210)	26 (118/449)

[†]Values are percentages % (*n*/total *n*). [‡]Food group included in the dietary diversity indicator. Note: Given the small *n* values particularly in the youngest age groups, caution should be taken when considering the precision of the results.

Table 4. Nutritional contribution of selected commercial highly processed snacks and sugar-sweetened beverages in *Los Cuatro Santos*, Nicaragua, 2009

Item (package size, g or mL)	Labelled portion size [†] and nutritional content	Contribution to recommendation [‡] (%)		
		Age group (months)		
		6–8	9–11	12–23
Crispy salty snacks				
Cassava crisps (28 g)	28 g			
Energy (kcal) [§]	140	23	20	16
Total fat (g) [¶]	7	30	15	20
Saturated fat (g) ^{††}	4	61	52	40
Sugars (g)	2	–	–	–
Sodium (mg) ^{‡‡}	220	83	75	53
Cheese corn crisps (28 g)	28 g			
Energy (kcal) [§]	162	27	23	18
Total fat (g) [¶]	10	43	37	29
Saturated fat (g) ^{††}	4.3	65	56	43
Sodium (mg) ^{‡‡}	326	122	118	78
Flavoured corn crisps (28 g)	28 g			
Energy (kcal) [§]	154	26	22	17
Total fat (g) [¶]	8	40	34	27
Saturated fat (g) ^{††}	2.2	33	29	22
Sodium (mg) ^{‡‡}	309	116	106	74
Cheese crackers (408 g)	34 g			
Energy (kcal) [§]	170	28	24	19
Total fat (g) [¶]	9	45	39	30
Saturated fat (g) ^{††}	4.5	68	58	45
Sugars (g)	4	–	–	–
Sodium (mg) ^{‡‡}	420	158	144	101
Sweet snacks				
Cream cookies (300 g)	25 g			
Energy (kcal) [§]	110	18	16	12
Total fat (g) [¶]	3.8	19	16	13
Saturated fat (g) ^{††}	2.1	32	27	21
Sugars (g)	8	–	–	–
Sodium (mg) ^{‡‡}	48	18	16	12
Butter cookies (312 g)	26 g			
Energy (kcal) [§]	125	21	18	14
Total fat (g) [¶]	6	30	26	20
Saturated fat (g) ^{††}	3	45	39	30
Sugars (g)	6	–	–	–
Sodium (mg) ^{‡‡}	115	43	39	28
Sugar-sweetened beverages				
Powdered fruit drink (30 g)	7.5 g			
Energy (kcal) [§]	30	5	4	3
Sugars (g)	6	–	–	–
Sodium (mg) ^{‡‡}	–	–	–	–
Iron (mg)	NA	NA	NA	NA
Vitamin A (μg)	154.4	53	53	46
Vitamin C (mg)	9	43	43	36
Powdered fruit drink (35 g)	7 g			
Energy (kcal) [§]	26	4	4	4
Sugars (g)	6	–	–	–
Sodium (mg) ^{‡‡}	–	–	–	–
Vitamin A (μg)	92.6	32	32	28
Vitamin C (mg)	19.4	96	96	78
Zinc (mg)	4.8	48	48	48
Carbonated soft drink (100 mL)	100 mL			
Energy (kcal) [§]	42	7	6	5
Sugars (g)	11	–	–	–
Sodium (mg) ^{‡‡}	–	–	–	–

NA, not available. [†]In most cases, individually packaged within the larger package; [‡]Micronutrient contributions based on Estimated Average Requirements (EARs) and energy and fats requirements based on Recommended Dietary Allowances (RDAs); [§]Energy requirements are based on average breast milk intake, (PAHO 2003); [¶]Based on 30–35% of lipid requirements considering total energy intake of 6- to 35-month-olds (Uauy & Castillo 2003); ^{††}Based on less than 10% of saturated fat requirements considering total energy intake of 6- to 35-month-old children (Uauy & Castillo 2003); ^{‡‡}Based on 1998 WHO/FAO estimates of micronutrients and sodium daily needs (Dewey & Brown 2003).

differences in consumption of HP snacks and/or SSBs were observed between children who either met or did not meet minimum meal frequency (data not shown).

Discussion

Breastfeeding was practised among mothers of all newborns and remained common beyond infancy. Nonetheless, only about one-third of the 0- to 5-month-old infants were exclusively breastfed, as beverages and foods were introduced at a very early age. The IYCF practices were inadequate in terms of meal frequency and dietary diversity; particularly noteworthy were the low levels of children's consumption of vitamin A-rich fruits and vegetables and meat products. A concern is the young children's substantial consumption of commercial SSBs and sweet or salty high-energy-dense snacks.

Breastfeeding was common and frequently continued beyond 12 months of age. This finding is consistent with a previous report of the mean predicted duration of 19 months in Nicaragua (Chaparro & Lutter 2011). However, the proportion of 0- to 5-month-old infants who were exclusively breastfed was small. The most common items given to infants, who, according to their age, should have been exclusively breastfed, were water, formula or powdered milk. Water and water-based drinks are of concern in particular, given that a majority of households lacked tap water, thus increasing the risk of viral and bacterial exposure and subsequent infections. Further, formula was an apparent breast milk substitute for some of the youngest infants. The negative effects of breast milk substitutes are well known in that they may result in lower breast milk production, the infant may receive lower quantities of important nutrients and also miss out on the other beneficial effects of breast milk, which may ultimately lead to increased morbidity (Kramer & Kakuma 2012) and thus hamper growth (Richard *et al.* 2013). Breastfeeding has also been found to have a moderate protective effect against becoming overweight later in life (Weng *et al.* 2012), which may be of particular relevance in this setting experiencing the nutrition transition.

Beyond early infancy, complementary and young child feeding was poor in *Los Cuatro Santos*. Dietary diversity was unmet by 50% of 6- to 11-month-olds and, in particular, there was a low prevalence of infants who consumed vitamin A-rich fruits and vegetables and meat products. A low dietary diversity has been linked to higher rates of stunting (Arimond & Ruel 2004) and it might be a contributing factor to the high prevalence of chronic undernutrition in the area. As dietary diversity was higher among the older children, a low dietary diversity in the younger children may not be explained solely by limited access but likely also, in part, be due to insufficient caretaker knowledge on the importance of a diverse diet. Moderate levels of dietary diversity in *Los Cuatro Santos* might be also due to a combination of low availability and accessibility driven by the high cost of high-quality foods and a poor household economic situation among local families. Additionally, seasonality of fruits and vegetables, coupled with low numbers of home gardens, might limit local home-stead food production. The study period took place during the rainy season when accessibility of fruits and vegetables may be low due to low production and concurrent high prices. Furthermore, the long distances to local markets and limited cold storage capacity for perishable products might also prevent households from acquiring micronutrient-rich foods.

Concurrent with low rates of exclusive breastfeeding and poor complementary feeding practices, we found a high prevalence of children who consumed HP snacks and SSBs. In contrast to high-quality foods, these were highly available (appearing in even the smallest stores in a village) and accessible due to their relatively low cost. The consumption of SSBs started early enough to pose a threat to exclusive breastfeeding. The most commonly consumed sugary drink was coffee with sugar that is part of a typical family breakfast and a widely drunk mid-afternoon beverage, contributing to overall sugar intake. Commercial powdered fruit drinks labelled as vitamin A-, C- and zinc-enriched fruit beverages were also frequently consumed. It appeared that these drinks were not high in sugar if simply mixed with water, but the mothers in our study routinely added

sugar to these drinks, once again contributing to overall sugar intake. Over 80% of children older than 2 years of age had consumed a SSB the day preceding the interview. This finding mirrors the global trend of high consumption of SSBs in low- and middle-income countries (Popkin *et al.* 2012). Consumption of SSBs may reduce intake of breast milk and displace consumption of nutrient-rich foods and thus contribute to inadequate length development. Intake of SSBs has been also associated with weight gain even among 2- to 5-year-old children (Malik *et al.* 2013). A potential mechanism in this association is that carbohydrates in liquid form produce less satiety levels than solid carbohydrates thus increasing daily energy intake (Pan & Hu 2011). Apart from the association of SSBs with weight gain, fructose-sweetened beverages may increase visceral adiposity, which is linked to a higher risk of cardiovascular diseases (Stanhope *et al.* 2009). Fructose also has the metabolic particularity, unlike glucose, of producing uric acid, which contributes to body fat accumulation (Lanaspa *et al.* 2012). In addition to the above physiological factors of sweetened beverages, a preference for them at an early age may also contribute to later intake in adolescence, increasing the possibility of diets higher in free sugars (Fiorito *et al.* 2010).

Industrially produced sweet or salty high-energy-dense snacks such as cookies, candies and crisps were also commonly consumed by children older than 6 months, which might increase the likelihood of two scenarios that could be associated, ultimately, to child overnutrition. One of the scenarios is that HP snacks could displace nutrient-rich foods, which in turn could be associated with micronutrient deficiencies and therefore stunting. Stunted children have been found to be at increased risk of becoming overweight (Popkin *et al.* 1996). A second potential scenario is that children's consumption of HP snacks could promote high levels of energy intake resulting in greater odds of child overnutrition as well. The latter scenario has been reported among children in the United States (Nicklas *et al.* 2003). Similarly, one report has documented the association of high-energy-dense snacks, including SSBs, with child overweight and obesity in a rural setting in Mexico (Jimenez-Cruz *et al.* 2010). It is likely, however, that

both displacement of nutrient-rich foods and excess consumption of HP snacks by some of the children could be occurring in the study area. In terms of the unfavourable effects of consumption of HP snacks, these high-energy-dense foods have been found to have lower satiety values (as opposed to nutrient-rich foods) resulting in higher caloric intake (Wansink *et al.* 2011). The inherent preference for sweet or salty tastes may be also heightened in environments where young children are exposed to foods and beverages high in sugars or salt at a very early age (Mennella 2014). Thus, children's familiarisation to HP snacks and SSBs when they are very young may have profound effects on future frequency of intake (Birch & Doub 2014) and may thus contribute to non-communicable diseases. The commonly consumed crispy snacks high in salt, for instance, could be adding to the non-communicable disease burden. A high level of sodium has been associated with an elevated risk for high blood pressure among children and adolescents in the United States (Yang *et al.* 2012). We cannot rule out, nevertheless, that other drivers apart from the dietary intake of processed foods and beverages could be contributing to overnutrition, given its intrinsically multifactorial nature (Monasta *et al.* 2010).

This study was population based, had a high participation and a sufficiently large sample size. A limitation, nonetheless, is the cross-sectional design, so the prevalence of exclusive breastfeeding could have been overestimated as mothers could have provided other liquids or foods on other days prior to the survey. Mothers could have also interpreted meal frequency as meals and snacks, while other might have not. Additionally, we cannot rule out the general weaknesses of recall data such as being dependent on maternal memory and that the results may be prone to biases due to social desirability in responses. While a dietary list-based approach may produce response fatigue in the mothers that could hamper the validity of the information, this approach was chosen as it was considered to minimise memory bias. In spite of the above limitations, our findings are likely generalisable to settings in Nicaragua with similar agro-ecological traits and socio-economic characteristics.

In this rural society undergoing a nutrition transition, IYCF practices showed behaviours that may result in risks for both under- and overnutrition. Efforts to improve feeding behaviour need to address both recommended feeding behaviours as well as intake of highly processed sweet or salty crispy snacks and SSBs. There is a need to improve the commonly used tools to assess IYCF to monitor progress in the promotion of appropriate IYCF practices so that they also encompass potentially unfavourable feeding behaviours such as consumption of HP snacks and SSBs.

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Conflict of interest

The authors declare that they have no conflict of interests.

Contributions

EE designed and guided the child feeding and nutrition component of the HDSS survey round that was headed by EZ and assisted by MC who also supervised the field work, analysed and interpreted the data and drafted the manuscript under guidance of EE. LAP and EZ contributed in interpretation of results and reviewed the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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