Original Article

Mixed-methods study identifies key strategies for improving infant and young child feeding practices in a highly stunted rural indigenous population in Guatemala

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Abstract

Guatemala's rural indigenous population suffers from one of the highest rates of chronic child malnutrition (stunting) in the world. Successfully addressing stunting requires defining the barriers to and opportunities for new behaviour-change initiatives. We undertook a mixed-methods assessment of feeding practices and food purchasing behaviours around infants and young children aged 6–36 months in two rural indigenous Guatemalan communities. We found that most caregivers were aware only of acute forms of child malnutrition and that they greatly underestimated the local prevalence of malnutrition. Despite moderate adherence to exclusive breastfeeding and timing of complementary food introduction, diets had poor diversity and inadequate meal frequency. Furthermore, perceptions of food insecurity were high even in the presence of land ownership and agricultural production. Although fortified foods were highly valued, they were considered expensive. At the same time, proportionally equivalent amounts of money were spent on junk foods or other processed foods by most participants. Biological mothers often lacked autonomy for food purchasing and nutritional decisions because of the power exerted by husbands and paternal grandmothers. Our findings suggest several creative and community-based programming initiatives including education about the acute vs. chronic malnutrition distinction, engaging landowners in discussions about domestic food consumption, engaging with caregivers to redirect funds towards fortified foods rather than junk food purchases and directing behaviour-change initiatives towards all household stakeholders.

Keywords: multidisciplinary approaches, child nutrition, complementary foods, cultural issues, ethnicity, low-income countries.

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Introduction

Guatemala has the highest rate of stunting in the America (Loewenberg 2009). According to national surveys, 43% of children under 5 years are stunted; these rates are often 50% higher for the indigenous Maya, who represent at least 40% of the total population (Ministerio de Salud Pública y Asistencia Social (MSPAS) 2009a). Since 2012, Guatemala's executive branch has launched a national plan, Hambre Cero (Zero Hunger), to combat child malnutrition, which includes growth monitoring and distribution of multiple micronutrient powders (MNPs) (Secretaría de Seguridad Alimentaria y Nutricional (SESAN) 2012). Nutritional supplementation is also a major focus for the non-governmental sector in Guatemala (Kraemer & Rohloff 2013), and both clinical and pragmatic trials of ready-to-use supplements,

such as lipid-based nutritional supplements (LNS) and MNPs, are underway (International Food Policy Research Institute (IFPRI) 2013; Matias *et al*. 2011).

Despite these initiatives, there are significant logistical and cultural challenges to effectively combating stunting in Guatemala. The indigenous Guatemalan diet is largely plant-based and, as with similar diets worldwide, it is difficult to meet the micronutrient needs of infants and children from local foods (Dewey & Brown 2003; de Pee & Bloem 2009; Vossenaar & Solomons 2012). Overall, it is challenging to meet the micronutrient needs of infants and children without supplementation, even though overall energy requirements are met by local diets (Food and Nutrition Technical Assistance III Project (FANTA) 2013). Furthermore, rising food costs have negatively affected dietary quality, leading to reduced consumption of critical micronutrients by the most impoverished Guatemalans (Iannotti *et al*. 2012). Although monthly costs of a minimally acceptable diet for an average household can be met by those earning the legally mandated minimum wage, many indigenous Guatemalans participate in the informal economy and therefore do not earn this minimum wage (Coronado 2013). This means most indigenous families cannot afford to meet the food-based dietary recommendations for their children (FANTA 2013). Furthermore, food security and food commodities prices are not the only barriers to improved child nutrition in Guatemala. Few studies gauge adherence to optimal infant and young child feeding (IYCF) practices in Guatemala, but available data suggest that adherence to exclusive breastfeeding and timely introduction of complementary foods is low (Instituto de Nutrición de Centro América y Panamá (INCAP) 2012). Many IYCF practices are amenable to behaviour-change communication (BCC) strategies, and a detailed understanding of local practices can help guide the focus of nutrition education programmes.

Against this background, multidisciplinary research exploring cultural barriers and local bottlenecks to effective nutrition programming is needed. In recent years, multidisciplinary, mixed methods in nutrition science have gained traction worldwide (Pelto & Armar-Klemesu 2012; Kodish & Monterrosa 2013). For example, mixed methods were recently used to explore the barriers to MNP distribution in a refugee camp in Kenya (Kodish *et al*. 2011). Numerous feasibility studies for supplement-based programming (Tripp *et al*. 2011; Locks *et al*. 2013; Pelto *et al*. 2013), as well as studies exploring effective behaviour-change strategies for food-based recommendations (Penny *et al*. 2005; Monterrosa *et al*. 2013; Monterrosa *et al*. 2012), have also employed mixed methods.

We performed a mixed-methods study of IYCF, food purchasing and decision-making roles in households, local perceptions of fortified foods, and local market forces in two rural Maya Guatemalan communities. Our research explored the barriers induced by poverty and vulnerability that restrict options for optimal food-based recommendations in this population. We were especially interested in uncovering 'hidden resources' – such as small amounts of money currently spent on non-nutritive foods. These resources may form the basis for incremental

Key messages

- A mixed-methods study of infant and young child feeding behaviours in rural indigenous Guatemala highlights moderate adherence to exclusive breastfeeding and complementary food introduction, but also underscores ongoing deficiencies in dietary diversity and meal frequency.
- High rates of land ownership and agricultural production did not result in improved perceptions of food security or in improved dietary diversity. Land is used primarily for export crops, and future research should explore whether food production for local consumption can be reintroduced.
- A major barrier to community programming around stunting was the widely held perception that malnutrition occurred only 'in other communities' and confusion of acute and chronic malnutrition.
- Commercial foods, including both fortified foods and junk foods, were regularly consumed. Fortified foods were highly regarded but expensive. However, household money spent on junk foods may represent a 'hidden resource' that could be diverted towards increased purchasing of fortified foods and other healthier items.

behaviour change and social marketing initiatives and could promote community and caregiver engagement in nutritional programming. The mixed-methods approach allowed us to explore community and caregiver motivations and practices, which are targets for future BCC initiatives.

Materials and methods

Study site and ethics

The study was conducted in two rural indigenous Maya communities with established partnerships with the sponsoring organisation Wuqu' Kawoq. One community, K'exel, is located in the department of Suchitepéquez; the other, Xejuyu', in the department of Chimaltenango. Previous demographic surveys have been conducted. K'exel contains approximately 100 families and 28% live on less than $2 USD per day. The primary language is Spanish, although K'iche' and Kaqchikel Maya are also spoken. The stunting prevalence for children 6–59 months is 71% (Chary *et al.* 2013). Xejuyu' contains approximately 230 families and 45% live on less than $2 USD per day. The primary language is Kaqchikel Maya. The stunting prevalence for children 6–59 months is 57% (Wuqu' Kawoq, unpublished observations, 2011). Land ownership and agricultural lifestyle differ in the two communities, described in Table 1. Also, we had anecdotal evidence from prior clinical and program-

matic activities that K'exel had higher rates of processed food consumption. We studied these two communities because we hypothesised that the differences (agriculture, processed food consumption, indigenous language use) were related to IYCF practices or food security. The study was approved by Wuqu' Kawoq's institutional review board. In each community, the study was also approved by local elected officials and was then introduced to the larger community through town hall meetings to solicit feedback and consent. Town names are pseudonyms. All individuals who participated in the study provided verbal informed consent.

Study design and data collection

Data were collected using a mixed-methods approach. Qualitative methods included focus group discussions (FGDs) with caregivers and key informant interviews (KIIs) with community leaders and non-governmental organization (NGO) staff. Quantitative methods included structured surveys with primary caregivers and local store vendors. To expedite data collection, two multidisciplinary research teams, including anthropologists, physicians, nutritionists and trained local field staff, worked independently in each community, one recruiting participants for and conducting quantitative research, and the other recruiting for and conducting qualitative

Table 1. Major demographic characteristics of study communities

Characteristic	Xejuyu'	K'exel	*P*-value*
Household size (mean ± SD)	7.15 ± 3.04	6.78 ± 2.89	0.53
Children living in home (mean ± SD)	4.23 ± 2.52	3.62 ± 2.24	0.20
Age of child subject of structured survey (months, mean ± SD)	17.37 ± 7.74	19.34 ± 8.63	0.23
Primary caregiver is mother (%)	96 (48 out of 52)	96 (48 out of 50)	0.41
Primary caregiver education (years, mean ± SD)	3.15 ± 2.21	3.84 ± 4.55	0.33
Primary caregiver literacy (%)	50 (26 out of 52)	58 (29 out of 50)	0.42
Household employment (%)	Subsistence agriculture (50%, 24 out of 48) Unskilled/day labor (33%, 16 out of 48)	Unskilled/day labor (76%, 38 out of 50) Subsistence agriculture (2%, 1 out of 50)	<0.001
Land ownership (%)	69 (36 out of 52)	28 (14 out of 50)	<0.001
Grows food for own consumption (%)	67 (35 out of 52)	26 (13 out of 50)	<0.001

*P-value for comparing variables obtained during the structured survey between the two study communities; Student's *t*-test for continuous variables and chi-square for categorical variables.

research. In K'exel, all data collection occurred in Spanish; in Xejuyu', all data collection occurred in Kaqchikel Maya.

FGDs

Ten focus groups were conducted with caregivers of children aged 6–36 months, focusing on (1) perceptions of child illness and malnutrition; (2) infant feeding practices; (3) household roles in infant caregiving, nutritional decision-making and food purchasing; and (4) knowledge and utilisation of commercial and fortified foods for infants and children. In each community, one focus group was held with male caregivers and four were held with female caregivers. Focus group sizes ranged from four to 10 participants. Discussions ranged from 90 min to 150 min, and were digitally recorded and transcribed.

KIIs

Semi-structured interviews were conducted with community leaders and NGO staff working in each community. These interviews addressed opinions about community-level awareness of malnutrition and best strategies for infant feeding-related behaviour change. In K'exel, three NGO staff members and eight community authorities participated in the interviews. In Xejuyu', interviews were conducted with six NGO staff and six community leaders. Interviews lasted from 30 min to 60 min and were digitally recorded and transcribed. In both communities, all community leaders were also caregivers, which allowed some corroboration of themes from the FGDs.

Surveys with store vendors

A total of 61 surveys about food availability and purchasing behaviours were conducted in stores selling food in and near both communities. All stores within each community (15 in Xejuyu', nine in K'exel) participated in the survey; all stores were located within 1 km of the town centre. Also, as town residents travel to urban centres nearby to purchase foods on market days, surveys were conducted with a convenience sample of stores in the nearest large town (Table 1).

In the town nearest Xejuyu', about 20 km away, 20 store vendors participated. In the town nearest K'exel, about 10 km away, 17 store vendors participated. The survey contained 34 questions to determine: (1) vendors' perceptions of what constituted 'food for children', 'fortified foods' and 'junk food';[1] and (2) clientele and purchasing behaviours.

Structured surveys

A structured survey consisting of 148 items was conducted with primary caretakers of children 6–36 months. The survey queried for (1) basic demographics; (2) breastfeeding and complementary feeding practices; (3) decision-making and food purchasing roles; (4) 24-h and 7-day food recalls; and (5) purchasing and feeding behaviours related to commercial foods, including fortified foods, junk foods and foods specifically for children. The survey was administered to 52 caregivers in Xejuyu' and 50 caregivers in K'exel after pilot testing with four caregivers in Xejuyu'. Households were chosen for participation using a systematic sample of every third household with a child of the correct age. Given the independent nature of the qualitative and quantitative data collection, overlap between the FGD sample and the structured survey sample was not tracked. As part of the structured survey, 24-h food recalls and meal frequencies were determined for the child in question, following established World Health Organization (WHO) methodologies (WHO 2008). Quantification of portion sizes of foods (Campos *et al*. 2010) was not performed because of time limits. To elicit feeding patterns over a longer time period, a 7-day food frequency questionnaire (FFQ) was also administered. The decision to administer the FFQ instrument was

[1]In the paper, we use the following working definitions: *Commercial foods:* packaged foods that can be ready-to-eat or require cooking or preparation. Three subtypes: *Foods for children* are foods that are specifically marketed to children or that are perceived by the community to be primarily for children. *Fortified foods* have added vitamins, minerals or other nutrients, such as protein, that are not naturally occurring in the food. *Junk foods* are foods with little nutritional quality that usually require minimal or no cooking or preparation.

based on the published literature in Guatemala showing that 24-h recalls underestimate dietary diversity (Rodriguez *et al.* 2002). The FFQ included 53 foods and 15 beverages from a locally validated and published list (Rodriguez *et al.* 2002); and in the analysis phase, we grouped these items into both the WHO food categories and several additional categories of interest, such as sugared beverages and fortified foods (Table 3).

Data analysis

For qualitative data (FGDs, KIIs), two researchers reviewed transcripts to generate a preliminary codebook, which was reviewed and modified by other investigators in two rounds. Data were coded thematically by two teams of two researchers each using the Coding Analysis Toolkit (http:// cat.ucsur.pitt.edu). Each team worked independently. Transcripts were coded twice, once by each team, and code-by-code comparisons were reviewed by the senior members of each team to resolve disputes in coding.

Quantitative data (structured surveys, vendor surveys) were coded into spreadsheets and checked for accuracy by two authors. Descriptive statistics were generated with STATA (Statacorp, College Station, TX, USA). Comparison of variables from the two study communities were conducted using the Student's *t*-test (for parametric continuous variables), Wilcoxon rank-sum test (for non-parametric continuous variables) and either the chi-square or Fisher's exact test (for categorical variables).

After basic data processing was completed, iterative group meetings between the qualitative and quantitative analysis teams served to clarify the findings of each team and structure the presentation of findings. The usual procedure was for the quantitative analysis team to present the descriptive statistics of the structured and vendor surveys for a defined subarea of the study. The qualitative analysis team would then examine the coded transcript data from FGDs and KIIs for items shedding further light on the quantitative data. In this way, e.g., a quantitative finding of poor dietary diversity indices alerted the qualitative analysis team, which subsequently noted that food insecurity was a prevalent and highly relevant theme in the coded FGDs.

Results

Our mixed-methods approach generated findings in five major thematic areas. These included: (1) local perceptions of malnutrition, especially as related to symptoms, causation and potential solutions; (2) qualitative and quantitative data on breastfeeding practices and complementary feeding initiation; (3) child dietary patterns, including quantitative data on food and meal frequencies, dietary diversity and the use of special supplementary children's foods, as well as qualitative data on perceived food insecurity; (4) household roles in decision-making concerning food purchasing; and (5) local perceptions of and consumption and spending patterns on commercial, fortified and junk foods. Detailed findings are presented in this order.

Perceptions of malnutrition

Symptoms of malnutrition

FGDs participants were asked to describe the physical characteristics of a malnourished child. Overwhelmingly, respondents described acute malnutrition (thin, visible ribs, swollen stomach). Participants also reported effects on developmental milestones (delayed walking or talking), energy level (fatigued, not participating in usual play activities) and feeding behaviours (anorexia or rejection of specific foods). Jenifer, a mother from Xejuyu', remarked, 'the [malnourished] child is tired, doesn't want to play, and eats little.' Similarly, Irene, a mother from K'exel, stated, 'when a child is malnourished, he looks pale. They don't look their normal color. Children like that don't eat and they don't play.' Few FGD or KII participants characterised child malnutrition as a serious problem in their community. Some felt that malnutrition was mainly a problem in other areas of Guatemala, as characterised by photos of emaciated children published in national newspapers. Stunting or chronic malnutrition was not mentioned in any of the FGDs

or interviews with community leaders, despite NGO nutrition programming in the area focused specifically on this form of malnutrition. Flavio, an NGO staff member in Xejuyu', remarked, 'although you might ask someone, "Does your child have malnutrition? What do you think?" They respond, "Does he have it or not? I can't tell." '

Causes of malnutrition

FGD participants attributed child malnutrition to lack of quality food, stemming from limited economic resources. Juan, a male participant from K'exel, stated, 'where does it [malnutrition] come from? It comes from extreme poverty. There is no food.' A female participant from K'exel, Ana, remarked, 'their weights are affected because of a lack of food.' FGDs and KIIs identified other factors that contribute to child malnutrition including lack of caregiver knowledge about recognising malnutrition, suboptimal feeding behaviours (inappropriate breastfeeding duration, meal frequency or quantity and junk food consumption), poor hygiene behaviours (lack of hand washing, allowing children to crawl in dirt, inattention to child's nutrition and health status) and common illnesses and infections (and associated poor appetite, diarrhea and vomiting). Regarding the last topic, Araceli, a woman from Xejuyu', remarked: 'kids always get diarrhea and vomiting. There are many kids who suffer from it. It could be that it's a cause of malnutrition – that they always have diarrhea, vomiting, that might make them worse.' Additionally, concerns over inadequate birth spacing arose in both women's and men's FGDs in both villages. Antonio, a man from Xejuyu', remarked, 'sometimes, when one doesn't use birth control, the woman is still breastfeeding when she becomes pregnant again, and that's when the children turn out malnourished. The woman still hasn't recuperated [w]hen she gets pregnant again'.

Solutions to malnutrition

FGD participants were also queried for ideas of potential solutions to child malnutrition. Responses in both communities were similar and included providing supplemental foods, vitamins and medical care to children. Flora, a mother from K'exel, commented, 'I would take the child to the hospital or the health center or see what I have to do, because if the child becomes serious, he could die'. FGDs revealed that caregivers felt it was necessary to provide malnourished children with larger quantities of food, foods with higher vitamin content or specific foods such as milk, grain products, fruits and vegetables or micronutrient supplementation. However, upon further query, these strategies were almost exclusively linked to cases of acute malnutrition. Micronutrient supplements or supplemental foods were thought to help prevent and cure malnutrition, prevent anaemia, help a child gain weight and restore appetite. A frequent caveat in FGDs was that supplements were not helpful if concurrent medical illnesses were not simultaneously addressed.

IYCF practices

Breastfeeding

Among all children aged 6–36 months (structured survey data), 79% (80 out of 101) were still breastfeeding. This proportion increased to 90% (76 out of 84) for children aged 6–24 months. The average age at breastfeeding cessation in both communities was somewhat less than the WHO-recommended breastfeeding duration of a minimum of 24 months (20.55 ± 1.84 months in Xejuyu' and 17.45 ± 2.52 months in K'exel, $P = 0.33$). Survey data revealed that in both communities, the majority of caregivers reported more than 10 breastfeeding sessions per day. However, there was a difference in the duration of each session, with the majority (77%, 30 out of 39) in K'exel reporting breastfeeding for less than 10 min per session, while the majority (72%, 26 out of 36) in Xejuyu' reported breastfeeding for more than 10 min per session ($P < 0.001$). FGD participants reported actively weaning children (by discouraging breastfeeding or redirecting to complementary foods), rather than waiting for the child to self-wean. This was explained by the strong perception that breastfeeding a child while pregnant would result in the child becoming ill (with vomiting/diarrhoea).

Several participants confirmed the trigger for weaning was a subsequent pregnancy. Luisa, a mother in Xejuyu', remarked: 'once I get pregnant, I don't give the child his milk anymore . . . I prefer to give *atol* to avoid getting him sick'.

Initiation of complementary feeding

Only three of the 102 caregivers participating in the structured survey reported that their children aged 6–36 months were not yet taking complementary foods. In both communities, the average age at introduction of first liquids was 6.0 ± 3.0 months (range 0–17) and 7.3 ± 2.0 months (range 3–14) for solid foods. The percentage of caretakers that reported exclusive breastfeeding until age 6 months was 98% (51 out of 52) in Xejuyu' and 90% (45 out of 50) in K'exel ($P = 0.08$). The first solid foods given to infants included bean or potato puree, rice, noodles, instant soup mix and Gerber-brand commercial baby foods. There was a significant difference in the distribution of first liquids between the two communities. In Xejuyu', 87% (45 out of 52) of children received *atol* (semi-thickened, sweetened gruel) as their first liquid, whereas 57% (26 out of 46) of children in K'exel received a more nutrient-poor beverage (water or coffee with or without sugar, or an herbal tea) ($P < 0.001$).

During FGDs, mothers in both communities reported that they introduced complementary foods after noticing their children were still hungry after breastfeeding. Mothers also were aware of the associated between acute illnesses and the initiation of solid foods. As Elvira, a woman from Xejuyu', described, 'I think that after 6 months, the child begins to eat. You can give him a piece of fruit, apple, or mango. Those won't harm him . . . what I do is give the child potato, squash, carrots. First I mash them up with a fork, then I give it to the child, so they don't get an infection. They say that when kids begin to eat, that's when they start to get sick'.

KIIs added the observation that mothers received mixed messages about the introduction of complementary foods. Eugenia, an NGO worker in Xejuyu', reported, 'sometimes the women receive a lot of information, but learning so much can confuse them. For example, there are those people that say breastfeed, breastfeed, breastfeed, but they don't say there is a limit. So you have to say to them [the mothers] at six months you need to start giving foods'.

Dietary patterns

Current diet

Fifty-seven food and beverage items were identified by caretakers during the 24-h food recalls. Of the 57 items, 15 were unique to K'exel, while six were unique to Xejuyu'. Most of the food items unique to K'exel were commercial foods, such as Gerber-brand baby foods, margarine, chocolates and cakes. Xejuyu' caregivers mentioned a wider variety of traditional greens and vegetables. In both communities, however, neither of these unique foods received a large number of mentions nor ranked among the foods most frequently mentioned (Table 2).

As 24-h recalls in Guatemala have been shown to underestimate caloric intake and dietary diversity (Rodriguez *et al.* 2002), we also performed a 7-day FFQ (Table 3). Key differences between the 24-h recalls and the FFQ included higher reporting of vegetables, fruits, fortified and packaged foods, and refined sugar on the FFQ. There were also more obvious differences between the two communities on the FFQ. In K'exel, children consumed significantly more fruits, animal flesh, eggs, dairy, refined sugar, high sugar beverages and junk foods. In Xejuyu',

Table 2. Most commonly consumed foods in 24-h food recalls

Xejuyu'		K'exel	
Food	Recall frequency	Food	Recall frequency
Tortillas	113	Tortillas	85
Atol	98	Coffee	59
Coffee	39	Eggs	28
Broth	31	Oil	27
Rice	28	Bread	25
Beans	25	Noodles	22
Oil	17	Rice	19
Eggs	16	Beans	18
Banana	16	Atol	13
Noodles	14	Cookies/crackers	10

Table 3. Seven-day food recall for children 6 to 36 months (servings per week±SD)

Food category	Xejuyu'	K'exel	P-value
Cereals and tubers*	20.7 ± 6.19	21.3 ± 7.71	0.68[†]
Vegetables*	15.4 ± 7.04	13.4 ± 8.34	0.33[‡]
Fruits*	4.02 ± 2.95	6.34 ± 4.15	0.01[‡]
Vitamin A rich foods*	3.46 ± 2.53	4.15 ± 3.3	0.51[‡]
Animal foods (including eggs)*	3.18 ± 2.11	4.45 ± 2.46	0.01[‡]
Legumes and nuts*	1.94 ± 1.83	2.45 ± 2.07	0.19[‡]
Dairy*	0.82 ± 1.26	4.53 ± 4.08	<0.001[‡]
Children's fortified foods	5.90 ± 2.61	4.74 ± 3.56	0.10[‡]
Commercial/packaged foods	3.94 ± 3.31	4.22 ± 2.97	0.41[‡]
Added fat	4.72 ± 2.62	4.83 ± 2.71	0.71[‡]
Junk foods	2.27 ± 2.62	9.36 ± 6.62	<0.001[†]
Refined (added) sugar	13.2 ± 6.13	20.3 ± 6.07	<0.001[†]
Soda and store-bought juice	1.81 ± 2.53	1.66 ± 1.75	0.73[†]
All high sugar beverages (home-made tea, coffee and juice drinks; store-bought soda and juice)	5.92 ± 5.05	7.22 ± 3.84	0.15[†]
Atols	6.02 ± 2.24	3.36 ± 2.45	<0.001[†]
Broth	3.17 ± 2.22	2.4 ± 2.03	0.08[†]

*WHO-defined food groups (WHO 2008). [†]Student's t-test. [‡]Rank sum test.

Table 4. Feeding indicators for children 6 to 23 months of age

Feeding indicator	Xejuyu'	K'exel	P-value
Minimum dietary diversity (%)	12.5% (5 out of 40)	35% (12 out of 34)	0.02
Mean number of food groups/24 h	2.12 ± 1.22	2.97 ± 1.14	0.003
Minimum meal frequency	6% (2 out of 35)	37.5% (12 out of 32)	0.001
Mean meal frequency/24 h	2.74 ± 0.85	3.21 ± 1.12	0.05
Minimum acceptable diet	2.86% (1 out of 35)	21.88% (7 out of 32)	0.02

children consumed more *atol* and broths. Although both communities are rural, in K'exel there is significantly more penetration of local markets by commercial foods, which may explain most of the differences on both 24-h recalls and FFQs identified here.

Feeding indicators

WHO feeding indicators for minimum dietary diversity (proportion of children consuming four or more food groups in 24 h), minimum meal frequency (proportion of children consuming solid or soft foods at least four times in 24 h) and minimum acceptable diet (composite indicator of minimum dietary diversity and minimum meal frequency) were calculated for both communities on the subset of surveys in our sample pertaining to children 6–23 months of age

(Table 4), the defined age range for the indicators (WHO 2008). These results are important because, despite our documentation of relatively high adherence to exclusive breastfeeding and complementary food introduction in both communities, all three indicators were very poor.

Special foods for children

Both FGDs and structured surveys explored whether special food purchases or preparation strategies were used for feeding infants and young children. In the structured survey, 8% (four out of 52) and 16% (eight out of 50) of caretakers in Xejuyu' and K'exel, respectively, reported buying foods specifically for their children (*P* = 0.19). Foods mentioned included instant soup mixes, refried beans, noodles, milk, eggs, oats,

corn flakes cereal, Gerber-brand infant foods and Nestle-brand infant cereal. However, in FGDs, participants reported that their families tended to eat the same foods without buying or preparing foods specifically for infants and young children: 'We all eat the same [food]' and 'We prepare everything together' were common refrains. As Magdalena, a woman from Xejuyu', remarked: 'almost everything is together. There's not a portion for the baby and separately food for us, everything is together. Whatever the food you eat, that's the food the child eats'. Among the few caregivers who did report buying special foods for their children, a common theme was experimenting with foods to provide their children with new tastes, although not regularly because of prohibitive cost.

Food insecurity

In FGDs, men and women in Xejuyu' and K'exel reported anxieties about food scarcity. A majority of families in Xejuyu' and a substantial minority of families in K'exel owned land and produced food for home consumption (Table 1). However, male FGD participants reported that food production was not sufficient to satisfy domestic consumption needs, making it necessary to purchase additional food. Lack of dietary diversity was attributed to financial difficulties. As Juan, a man from K'exel, noted, 'our biggest problem is that there isn't money. Because of this we can't buy foods that contain protein, have calories, so that our food is balanced'. During FGDs, men in both communities reported borrowing money to cover household expenses during agricultural off-seasons and subsequently repaying loans during harvest seasons. As Santurino, a man from Xejuyu', remarked: 'in this time [off-season] there is no work; there is no money [for food]'. Women stated that at times they did not have enough food for all household members. For example, one woman recounted sharing one egg between five children. Many female FGD participants reported only purchasing less expensive foods, rather than more desirable commodities such as beans or meat. Cecilia, a woman from K'exel, lamented: 'we have multiple children and sometimes we can't maintain them. That's what we as mothers and fathers have to think about first, the welfare of our children.

Because sometimes we can't give them shoes and clothes, and we don't have the money to feed them. That's when they become malnourished'.

Household roles and decision-making

Household roles

In the structured survey, the child's mother was usually the individual responsible for infant feeding and care. FGDs corroborated this expectation of mothers. María, a mother from K'exel, remarked, 'As mothers we always have to be conscious of their [our children's] food, what they eat, because if they eat something that doesn't agree with them, they could get sick'. However, other family members also played roles in child rearing and feeding. FGDs stressed the importance of fathers' economic contributions to feeding children. Mario, a father in Xejuyu', said, 'As the father it is my responsibility to not leave the children hungry'. The structured survey further revealed the importance of secondary caregivers. In Xejuyu', 44% (33 out of 52) of children had secondary caregivers other than their mother; in K'exel, the proportion was 30% (15 out of 50) ($P = 0.14$). In most cases, the secondary caregiver was a child's maternal or paternal grandmother or aunt. KIIs highlighted the importance of secondary caregivers and extended family members in shaping child-feeding practices. For example, Eugenia, an NGO worker in Xejuyu', noted that, 'Sometimes they say, "my grandmother says to give this food to my child, but not this [other] one" '.

Food purchasing

FGDs highlighted children's fathers as primary breadwinners, providing female members of the households with a portion of earnings for food purchases. Men participating in FGDs affirmed their control over household funds allocated to food. As Miguel, a male caregiver from Xejuyu', remarked, 'there is the culture of the man being the one who keeps the money and every so often he gives his wife money so she can buy some things'. Children's paternal grandmothers also exerted significant influence over food purchasing. From structured surveys, 21%

(11 out of 52) of mothers in Xejuyu' and 17% (nine out of 50) in K'exel reported that their mother-in-law was the female head of household. Several mothers reported their husbands gave money for household expenses directly to the mother-in-law rather than to them. Delmi, a female FGD participant living in her mother-in-law's house in K'exel, related that she had little say regarding which foods were purchased for her children, and she was not allowed to go shopping by herself: 'My mother-in-law is the one who is in charge of going shopping. My husband gives the money to his mother'.

Fortified and commercial foods

Fortified foods and child-specific foods

In all FGDs, vitamins were frequently mentioned as necessary to prevent malnutrition and encourage physical and mental development. Caretakers were familiar with the biological sources and functions of many vitamins. However, most were unfamiliar with the term 'fortified foods', even though this term (*fortificado*) was frequently used on local product packaging and in advertising in both Spanish and Kaqchikel Maya. However, when facilitators explained that fortified foods were foods containing added vitamins, caregivers immediately responded with a description of the popular commercial *atol* product, Incaparina. Others volunteered additional examples of well-known fortified foods, including hot cereal mixes, powdered milk, prepared juices and textured vegetable protein. In 24-h food recalls, the following fortified foods were mentioned: Incaparina (46 mentions), Nestle-brand infant formula (11), Quaker-brand hot cereal mixes (9), Gerber-brand infant purees (6) and Anchor-brand powdered milk (4).

To complement self-reported caregiver purchasing behaviours, we also conducted vendor surveys. More than 80% of the vendors surveyed in both communities sold fortified foods or other foods specifically for young children; the list of foods sold was identical to those mentioned above in the 24-h recalls. Vendors explained they marketed these products to potential buyers using the slogans and informational taglines printed on the products themselves, repeating them to

potential buyers (e.g. on a Quaker cereal product: 'Iron, calcium, zinc, vitamins: prevents anemia, strengthens bones, helps growth'). Vendors were asked to estimate the amount spent by their customers when purchasing fortified foods. Prices for the commonly mentioned items ranged from Q4 to Q9 (1 USD = approximately 8 Quetzales; Q4.07 ± 0.56 in Xejuyu' and Q8.93 ± 2.44 in K'exel, $P = 0.35$). FGDs underscored that for many families, these fairly nominal prices were often prohibitive. A female caregiver in Xejuyu' observed, 'If I buy a bag of Incaparina for my children, I am unable to buy corn to feed the rest of my family'. Another added, 'It's expensive, 10 Quetzales for one bag, and we need corn. You don't know whether to buy Incaparina or tortillas. The first thing we buy is the tortilla. If we buy Incaparina, we don't have tortillas'.

Commercial foods and 'junk' foods

In both communities, prepackaged commercial foods and 'junk' foods (*golosinas* or *comida chatarra* in Spanish) were a frequent topic of conversation. In structured surveys, the majority of caregivers reported regular consumption of these foods [81% (42 out of 52) in Xejuyu', 68% (32 out of 47) in K'exel, $P = 0.15$]. In our FFQ data, we stratified these purchases to differentiate between 'junk' foods (cookies, candies, potato or corn chips) and other prepackaged commercial foods (instant soup, noodle mixes or cereals). Both communities consumed similar amounts of commercial foods (around four servings per week), but weekly servings of junk foods were much higher in K'exel than in Xejuyu' (Table 3). As mentioned previously, this correlates with the higher level of market penetration of these items in K'exel overall. Most FGD participants felt that commercial and junk foods were unhealthy for children because of perceived chemical content, low levels of vitamins or 'indigestibility'. As Brenda, a female caregiver in K'exel, described, 'when you eat that food [commercial] that is already prepared, sometimes it doesn't suit you and you get sick'. Nevertheless, they often remarked that providing these foods as a snack was easier and less time-consuming than preparing snacks at home. One perceived advantage of these foods

over a fortified *atol* such as Incaparina was the money saved on fuel purchases, which is required for boiling the *atol*. Indeed, Victor, an NGO staff member in Xejuyu', identified this as a key reason that people purchase junk foods: 'It's easier than cooking. The children receive a little bit of money, buy it, and eat it very easily'.

Most surveyed vendors maintained a regular stock of fortified foods for infants and children, and some fruits and vegetables, as mentioned earlier. However, they reported that of all sales involving food purchases for children, 68% in Xejuyu' and 62% in K'exel ($P = 0.16$) were for junk foods. We queried vendors about the average per purchase amount spent on junk food purchases; in Xejuyu' the average amount was Q3.94 ± 0.35 and in K'exel it was Q5.48 ± 0.78 ($P = 0.06$).

Discussion

In this paper, we used mixed methods to explore concepts of malnutrition, IYCF practices and food purchasing behaviours in two rural indigenous Maya communities in Guatemala. There are several key findings. First, although stunting is highly prevalent, most caregivers were more aware of the symptoms of acute malnutrition and felt that malnutrition was not a significant problem in their community. In terms of optimal IYCF practices, exclusive breastfeeding to 6 months, extended breastfeeding into the second year of life and timely introduction of complementary foods were common, although many first complementary foods were of poor quality and nutrient density. Ninety per cent of children in our sample were breastfeeding in the second year of life, compared with 46% regionally, and 90% of children were exclusively breastfed to 6 months, compared with 56% regionally (INCAP 2012). These favourable comparisons with regional statistics may be the result of effective behaviour-change interventions, as both communities have a strong nutrition NGO presence. More investigation, outside the scope of this paper, would be required to clarify this point.

Another major finding was that, despite good adherence to basic IYCF indicators, dietary diversity and meal frequencies were poor (Table 4). These results are similar to the findings from another recent study in Guatemala, which showed that optimised diets based on local foods could not meet micronutrient requirements without the addition of supplements (FANTA 2013). Data from focus groups suggested that the high cost of food was a barrier to improving dietary quality, and subjective food insecurity and food rationing were common. This was especially the case for fortified foods and supplements, which were usually readily available in local markets, but thought to be prohibitively expensive.

We hypothesised differences in IYCF practices and dietary patterns between the two communities occasioned by their distinct features (higher rates of land ownership and indigenous language use in Xejuyu'; more processed food consumption in K'exel). Overall, IYCF practices were quite similar. Key differences were shorter breastfeeding sessions and more nutrient-poor first complementary foods in K'exel. Optimal meal frequency and dietary diversity were poor in both communities, but significantly worse in Xejuyu'. Survey data confirmed our hypotheses about differences in agricultural and processed food consumption, and food recall profiles subsequently differed.

A major goal of this research was to use mixed methods to uncover local strategies or 'hidden strengths' of the rural indigenous communities, which could be used to help formulate new programming or BCC strategies. Several findings of the study do suggest new strategies; we detail those in the succeeding sections.

Land ownership and food production

Preoccupation with food insecurity was a common theme, correlating with low meal frequency and dietary diversity indicators (Table 4). This was equally the case for Xejuyu' and K'exel, with the former having high levels of agriculture and land ownership (Table 1). Previous literature on the region encompassing Xejuyu' has documented the transition away from subsistence agriculture towards non-traditional export crops (Fischer & Benson 2006). Despite land availability, a majority of food being grown is for

export and does not impact local diets. This is an important finding, which fits into a larger literature on how 'modernizing' agricultural practices in the region have had minimal positive impact (Von Braun *et al*. 1989; Carletto *et al*. 2009). We are following this up with additional research in Xejuyu' on land and crop usage. Shifting food production back towards local consumption would be an obvious step towards improving dietary diversity, although it would not work as well in K'exel, where land ownership is less common. Research on the effectiveness of changing domestic food production patterns to improve dietary diversity and quality in developing countries is still limited, but promising (Bushamuka *et al*. 2005; Bhutta *et al*. 2013).

Perceptions of malnutrition and decision-making

Participants in our study felt that malnutrition was not a common problem within their own communities, occurring 'elsewhere' in Guatemala. This finding suggests inclusion of BCC strategies focused on raising awareness of the problem of chronic malnutrition among caregivers and community leaders. Previous research in Guatemala has described the normalisation of child stunting in high prevalence areas, where caregivers cannot recognise that their children are malnourished because it is 'normal to have short children' (Chary *et al*. 2013, p. 94). A positive deviance model, which highlights children who are growing better than their peers, may generate enthusiasm for nutritional programming among caregivers and community leaders (Bisits Bullen 2011; Chary *et al*. 2013).

In both communities, multiple household members were involved in food purchasing and decision-making. Paternal grandmothers were frequently primary decision makers and children's fathers often controlled available funds. These findings serve as an important reminder that BCC initiatives must include all stakeholders, not just biological mothers. Indeed, in other contexts, extended family approaches to BCC strategies have had positive impacts on nutrition outcomes (Aubel *et al*. 2004; Aubel 2006).

Fortified foods

Given the difficulty of providing nutritionally complete diets using local foods, we explored perceptions about and availability of fortified foods. As previously documented (FANTA 2013), one commercial fortified *atol* preparation, Incaparina, was highly regarded. However, other fortified cereal products and fortified milk were also locally available (price range Q4–9, USD $0.50–1.13), and food recall data showed that fortified foods were regularly consumed (around four to six servings per week). Therefore, it seems there is interest in and willingness to pay for commercial fortified food products, which could be a simple strategy for enhancing diets. Although participants frequently discussed the high cost of fortified foods, our recall data showed that, in addition to fortified food and junk food purchases, most children also consumed around three servings per week of 'other' commercial foods, such as instant soup. These low-quality foods were similarly priced to fortified foods, so encouraging caregivers to purchase more fortified foods in their place might be feasible. In K'exel, junk food consumption was also high (nearly six servings per week), with similar costs to fortified foods. Again, within a BCC initiative, this expenditure on junk food is a 'hidden resource' in the household that could be redirected towards fortified foods, fresh fruits or vegetables without additional financial strain. As similar dietary and purchasing patterns have been documented elsewhere in Central America (Leatherman & Goodman 2005), this could be a useful regional programming strategy.

Finally, interest in fortified foods raises the possibility for introducing new fortified foods. The main drawback to current commercially available fortified foods, such as Incaparina, is they are often excessively diluted, rendering them low in nutrient density. Also, they are time-consuming to prepare and require fuel to boil water and sugar to sweeten. These barriers can result in 'defaulting' to a more convenient junk food. Ready-to-use fortified foods or supplements, such LNS or MNPs, are an attractive alternative as they require no preparation.

LNS formulations are acceptable to rural Guatemalan populations (Matias *et al*. 2011; Nutriplus 2013)

and a trial of their effectiveness in Guatemala is underway (IFPRI 2013). In addition, efficacy trials in Ghana, Burkina Faso, Haiti and Malawi show positive results on growth and development (Adu-Afarwuah *et al.* 2007; Phuka *et al.* 2008, 2009; Iannotti *et al.* 2014). Local LNS production has recently begun in Guatemala (Nutriplus 2013). Similarly, MNPs have been available for several years (MSPAS 2009b) and are now used nationally in early childhood supplementation programmes (SESAN 2012), although efficacy research in stunting is still equivocal (Salam *et al.* 2013). Our data suggest that there may be a private market for new fortified foods or supplements in rural Guatemala, and further research should formally investigate willingness to pay and potential market size, analogous to work in other developing countries (Tripp *et al.* 2011; Segrè *et al.* 2012).

Study strengths and limitations

The main strength of our study is the use of a mixed-methods approach, which allows a detailed assessment of factors associated with child stunting in an indigenous Maya population. Another strength is the inclusion of two communities, which differed in terms of indigenous language use, land ownership and access to processed food. This allowed for a broader perspective on IYCF practice and dietary quality. The major limitation of our study is that both communities were from the Kaqchikel/K'iche' Maya central geographic area, so our results may not be entirely generalisable to other indigenous Maya communities in western or northern Guatemala. Another weakness, inherent in any study using qualitative methods, is that discussions with informants on sensitive topics, such as nutrition, may be influenced by the presence of the research team. Given the high level of NGO activity in both communities, respondents may have overemphasised some topics, such as food insecurity, that they perceived as important to our team of investigators. Similarly, in structured surveys, responses may have been influenced by an interviewee's existing knowledge of the 'right' answer, resulting in, e.g., overreporting rates of exclusive breastfeeding or complementary food introduction.

Conclusion and programming implications

We conducted a comprehensive mixed-methods study of IYCF practices, dietary quality and food purchasing behaviours in two rural indigenous Maya communities with high levels of stunting. The goal of the research was to identify resources within these communities which might serves as the basis for new nutrition programming or BCC strategies to combat child stunting. The two communities differed significantly in several ways, principally in terms of land ownership and processed food consumption. A key recommendation for further research and programming in Maya communities is to closely examine these factors prior to new programme implementation, as they could affect local needs and outcomes. Our study demonstrated that, despite good adherence to many optimal IYCF practices – such as exclusive breastfeeding – overall dietary diversity and meal frequency was very poor. Programming opportunities that might address these deficiencies include shifting of some agricultural production away from export crops back towards home consumption, combating the low recognition of chronic malnutrition at the community level through positive deviance models, engaging multiple household stakeholders in BCC strategies around food purchases and shifting food purchases away from low-quality processed foods towards fortified foods. Future directions for research, which we are actively pursuing, include exploring the relationship between land ownership, food production and nutritional outcomes more closely as well as formally exploring willingness to pay and market size for fortified food products.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

The study was co-conceived by Wuqu' Kawoq and Edesia, Inc. Wuqu' Kawoq is a non-governmental organization which develops health programmes in indigenous communities in Guatemala. Edesia, Inc. is a non-profit manufacturer of ready-to-use foods (RUFs) for use in the prevention and treatment of child malnutrition. KB conducted structured surveys, analyzed quantitative data, and wrote the first draft of the manuscript. NH designed the study and revised the manuscript. AC coordinated field implementation, designed the qualitative components, conducted focus groups and interviews, coded qualitative data and revised the manuscript. MFW conducted focus groups, coded qualitative data and revised the manuscript. HW and AKD coded qualitative data. JM and CB conducted vendor surveys. PR designed the study, analysed quantitative data and revised the manuscript.

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