Caregiver knowledge, attitudes and practices regarding vitamin A intake by Dominican children

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Abstract

Vitamin A deficiency (VAD) is a major concern in the Dominican Republic. Successful educational interventions are based on needs assessment data specific to the population for which behavioural change is desired. The purpose of this study was to establish a foundation for nutrition education efforts for caregivers of young children to prevent VAD in the Dominican Republic. A cross-sectional survey was administered to caregivers (N = 151) from rural/peri-urban villages in five provinces to assess vitamin A knowledge and attitudes, frequency of consumption of foods rich in vitamin A by an index child (age range 3–9 years), and food-related practices contributing to vitamin A intake. Caregiver knowledge regarding vitamin A was low in all villages regardless of differences in socio-economic status and level of education. A majority of the caregivers (67%) reported having a garden, but produce from the garden was thought mainly to provide a financial benefit vs. a nutritional benefit for the family. Several vegetables rich in vitamin A used as seasoning, mango, and unripe banana and plantain were commonly consumed by children as reported by caregivers. Educational interventions should focus on basic vitamin A knowledge regarding sources as well as symptoms of deficiency. Education should also emphasize increasing the variety of foods rich in provitamin A carotenoids grown in home gardens.

Keywords: vitamin A, Dominican Republic, caregivers, children, nutrition education.

Introduction

Micronutrient deficiencies, including vitamin A deficiency (VAD), pose serious health problems for children in many developing countries, such as the

Dominican Republic (Diaz *et al.* 2003; FAO 2003; UNICEF 2003). VAD can have detrimental effects in children on growth and development (Underwood & Arthur 1996; Biesalski & Nohr 2003), vision (Congdon *et al.* 2003) and the immune system (Bhaskaram 2002), leading to increased risk for mortality from infectious diseases, and poor school attendance, resulting in lowered educational attainment.

National survey data for the Dominican Republic regarding maternal and infant health from 1993 showed that between 18% and 20% of children aged

¹At the time these data were collected, this author was a returned Peace Corps volunteer who had completed service in the Dominican Republic.

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1–5 years had low serum retinol concentrations ($<20 \mu\text{g dL}^{-1}$), with higher percentages observed in the rural than in the urban areas (CENISMI 1995). The vitamin A (VA) supplementation rate for children aged 5 years and below was only 9% (percentage receiving at least one high dose of VA capsules in 2000) (UNICEF 2003). According to food supply data for the Dominican Republic, in the past 20 years the availability of fruits and vegetables decreased from 652 to 346 g per person per day, and in the past 30 years the availability of roots and tubers decreased from 176 to 62 g per person per day (FAO 2002). Fruits and vegetables as a source of energy decreased from about 22% in 1964–65 to about 7% in 1999–2001. This decline has implications for intake of foods rich in provitamin A carotenoids among children. National survey data also showed that in 1993, the prevalence of stunting (low height for age) was 19% (CENISMI 1995), with greater prevalence associated with poverty (Gwatkin *et al.* 2000).

A meta-analysis of intervention studies documented success regarding VA supplementation in decreasing childhood mortality and morbidity in developing countries (Beaton *et al.* 1993). VA supplementation has been widely adopted because of its simplicity and cost-effectiveness, but coverage and sustainability issues have yet to be resolved (Ross 2002). While supplementation remains a necessary and vital component of addressing VAD, other food-based approaches, including nutrition education, food fortification and dietary diversification programmes, may offer potential for long-term sustainability (Mora & Dary 1994; Allen 2003). Nutrition interventions using food-based approaches have been favourably associated with human and national development, stimulating economic growth (Demment *et al.* 2003).

Nutrition education objectives concerning VA have typically focused on increasing production, availability, accessibility and consumption of foods rich in provitamin A carotenoids and preformed VA. Limited information is available regarding nutrition education and behaviour change strategies to prevent VAD in developing countries (Ruel & Levin 2000). A better understanding of VA education needs is required

to develop education programmes for caregivers to prevent VAD among Dominican children. Thus, the purpose of this study was to assess nutrition education needs of female caregivers of young children regarding knowledge, attitudes and food-related practices to prevent VAD. Results can be used to develop educational interventions that could link local institutions, agricultural projects, and resources from health and women's projects to activities at the grassroots level to increase VA intake by children. Improvement in caregiver knowledge, attitudes and practices regarding foods rich in provitamin A carotenoids or preformed VA may lead to positive changes influencing intake of these foods by children.

Methods

Subjects and communities

Questionnaire data were collected by interviewers in a total of five communities, each in a different province in the Dominican Republic, with prevalence of stunting of children aged 6–9 years estimated at between 20% and 30% (FAO 2003). Communities within provinces were selected based on relationships with staff from aid organizations working in the community. Peace Corps volunteers living throughout the country provided the research team with preliminary demographic information about communities within the selected provinces. An effort was made to include communities that reflected the diversity of resident demographic characteristics according to size, location and type of livelihood.

Three of the five communities had between 100 and 300 residents (La Angostura, La Vega, located in the country's central mountain range, La Meseta, San Juan de la Maguana and Isidro Martinez, Elias Piña in the west near the Haitian border). The other two communities had between 1000 and 5000 residents (Las Gordas, Maria Trinidad Sanchez to the north near the Samaná peninsula and Los Hatillos, Hato Mayor in the eastern section of the country). All communities were rural agricultural communities typical of the Dominican Republic

except for Los Hatillos, which is a peri-urban community located approximately 3 kilometres south of Hato Mayor del Rey, the province capital of Hato Mayor.

Inclusion criteria included being a female caregiver 18–65 years of age of a child 3–9 years of age. Children in this age range were thought to still be dependent on their caregiver for food choices and thus were likely to be most affected by maternal characteristics such as VA knowledge. When the caregiver looked after more than one child in this age range (53%), the youngest was designated as an index child. Survey questions related to this child only as did height and weight measurements. A single caregiver was designated for an interview for each household. The study and all procedures were approved by the University of Minnesota Institutional Review Board: Human Subjects Protection Committee and included informed consent procedures.

Questionnaire development

The questionnaire was developed by the research team, which included a university nutrition faculty member, research assistant and Peace Corps volunteer. The questionnaire was based on current literature (Chitharanjan 2001; Faber *et al.* 2002; McLennan 2002) to assess caregiver nutrition education needs related to VA knowledge, attitudes and food-related practices. Health and agricultural workers from several agencies, including the Peace Corps and the Ministry of Health, were consulted to provide input into the development of the questionnaire items. The questionnaire contained items regarding household composition, education level of adults and employment. Socio-economic status (SES) was assessed according to ownership of consumer items, including a radio, stove, oven and motorcycle/moped; dwelling characteristics, such as flooring and wall material, number of rooms, and home ownership; and amount of land owned (possible range = 0–16). Other typical assets, such as the source of drinking water, electricity and toilet facilities, were not considered because they differed between communities within provinces, depending

on support from aid organizations and the Dominican government.

A series of questions to assess nutrition knowledge and attitudes regarding foods rich in preformed VA or provitamin A carotenoids were adapted from a similar measure used in South Africa (Faber *et al.* 2002). Open-ended questions involved the identification of (i) three foods that were good sources of VA (1 point for a correct answer out of 3); (ii) up to three colours of fruits and vegetables that were good sources of VA (1 point for either green, yellow or orange); and (iii) up to three symptoms related to a lack of VA (1 point for a correct symptom out of 3). Another item asked caregivers to select one food as a good source of VA from a list of five different foods (1 point if correct) (McLennan 2002). These points were summed to derive a final possible knowledge score (0–4 points). Other items pertained to general nutrition knowledge, the need for nutrition education at school, and whether nutrition information was provided to children by caregivers at home. Questionnaire items pertaining to VA, nutrition, food and health are listed in Table 1.

The questionnaire also included items regarding the use of foods from home gardens and animal

Table 1. Questionnaire items regarding vitamin A, nutrition, food and health

General nutrition, food and health items

What foods do you give a child for growth?

What foods do you give a child for healthy blood?

Does your child eat at school? (Yes or No) How does this affect how you feed your child at home?

Do you think your child should be taught at school about what foods they need to eat to be healthy? (Yes or No) If yes, what should he/she be taught?

Vitamin A knowledge questions¹

What causes a child to have night blindness?

What causes a child to have Bitot's spots?

What can someone do for night blindness or to see well at night?

Vitamin A Knowledge Scale²

Identify three foods that are rich in vitamin A.

Identify the color of foods that are rich in vitamin A.

Identify one symptom that may be related to vitamin A deficiency.

Which of the following foods is the best source of vitamin A?

Chicken, orange, carrot, cabbage, or plantain

¹Chitharanjan (2001). ²Faber *et al.* (2002); McLennan (2002).

foods to supplement the diets of children and purchasing habits regarding fruits and vegetables. Additional questions assessed attitudes regarding the benefits of home gardens and VA capsule supplementation.

Caregivers reported usual intake of selected fruits and vegetables over the past month by the child on a 5-point scale of 0 = never, 1 = monthly, 2 = weekly, 4 = 3–4 times a week, and 5 = daily. Fruit and vegetable items included were based on VA activity as reported in 1985 food composition tables for use in the Dominican Republic (Mussgay 1985). VA activity of the selected fruit and vegetable items was converted to retinol activity equivalents according to currently recommended conversion factors (FNB, IOM 2000). For reporting purposes, the frequency of consumption was converted from the 5-point scale into high (daily and 3–4 times per week), low (monthly and weekly) and never groups.

The questionnaire was revised following pilot interviews ($n = 4$) conducted during an early visit to one of the selected communities in conjunction with services of health and agriculture workers. The pilot test was used to check for clarity and understanding of questionnaire items. Additional interviewers were recruited and trained via practice administration of the structured questionnaire. When a collective sense of comfort was reached, several interviews were conducted by the new interviewer, with the research team present to provide further support. A total of five Spanish-speaking Peace Corps volunteers (one from each community) served as interviewers and administered the questionnaire only in their home communities.

Data collection

Three of the five communities were small enough to allow the interviewers to visit nearly all homes to determine whether eligible participants lived there (Isidro Martinez, La Meseta and La Angostura). Every household within the community boundary was assessed for eligibility, except those identified as ineligible by neighbours or relatives. In Los Hatillos, the entire community was divided geographically into

25 blocks of equal area, each containing approximately 30 households with roughly 150 inhabitants. Las Gordas, a smaller community where the houses were farther apart, was partitioned into five blocks of equal area, each containing approximately 35 households with roughly 175 inhabitants. A single block of homes was chosen at random in each community, and every household within the selected block was visited. The time required for the interview ranged from 25 to 60 min. Less than 5% of eligible caregivers refused to participate in the study.

Height and weight of children were measured while wearing light clothing and no shoes. Height was measured using a portable stadiometer (#214 Road Rod™, Quick Medical, Snoqualmie, WA, USA) to the nearest 0.1 cm. The weight measurements were taken to the nearest 0.05 kg using a high-quality electronic scale (ProFIT™ model UC-321, A&D Medical, Milpitas, CA, USA). Date of birth was obtained, and two measures of nutritional status were determined, including height for age and body mass index (BMI) for age. BMI was calculated as weight in kilograms divided by the square of height in meters.

Data analysis

Anthropometric data were analysed based on the 2000 CDC (US Centers for Disease Control and Prevention) Growth Charts as reference data and expressed as z -scores using SAS (The SAS Institute, Inc., 1999–2001, Version 8.2, Cary, NC, USA) (CDCP 2000). Children were defined as stunted if their height-for-age z -score was >2 SD below the mean of the CDC reference data [based on National Health and Nutrition Examination Survey (NHANES) data] or below the fifth percentile cut-off value (WHO 1995). Descriptive statistics (means and frequencies) were used as appropriate to assess responses regarding demographic characteristics, knowledge, attitude and food-related practices. ANOVA was used to test for mean differences in knowledge and SES across all communities after tests for normality showed that ANOVA was appropriate. Duncan's Multiple Range Test was used for pairwise comparison between individual communities. Chi-square analysis was used to test for differences between categorical variables by

community. A sample size calculation indicated that 34 subjects were required from each community for an 80% probability that the study would detect a difference of 1.0 unit in the VA knowledge score by community based on the assumption that the standard deviation of the VA knowledge score was 1.0 (http://hedwig.mgh.harvard.edu/sample_size/size.html). Significance level was set at 0.05.

Results

Characteristics of caregivers and children

Data were collected from caregivers in 151 households. Table 2 presents demographic and VA knowledge and food-related practice information for the overall group and by individual community. Participating households were fairly large, often containing a network of extended family members, with approximately one-third (36%) of the households containing at least one grandparent. A majority of the caregivers interviewed were mothers ($n = 101$ or 67%), while others were grandmothers ($n = 40$ or 26%) and aunts (7%). The proportion of mothers as respondents did not differ by province (60–81%, chi-squared: $\chi^2_4 = 3.0$, $P = 0.55$), while grandmothers made up 19–40% of each province sample. Approximately 17% of the children were stunted (<5th percentile height-for-age z -score), and 7% had a BMI-for-age z -score that was <5th percentile.

Educational attainment among caregivers was low, with 73% not attending school beyond the primary level. Mothers were younger and had higher levels of education than grandmothers (chi-squared: $\chi^2_3 = 14.3$, $P = 0.001$); however, no other differences were found for caregiver or child demographic characteristics according to whether the interview respondent was a mother or a grandmother. For example, SES was similar (mean = 9.7 for mothers and 10.1 for grandmothers), as well as number in the household (mean = 5.7 for mothers and 6.0 for grandmothers). In addition, no differences were observed for VA knowledge (mean = 1.6 for mothers vs. 1.7 for grandmothers) and practice variables (64% of mothers had a garden vs. 73% of grandmothers, and 71% of mothers owned animals vs. 83% of grandmothers). The agricultural

sector was the predominant type of employment among fathers (52%), while 83% of the caregivers reported working at home as a homemaker. Agriculture was the most common occupation among fathers in La Meseta (81%) and Isidro Martinez (74%) and less common in Los Hatillos (21%) and Las Gordas (32%) (chi-squared: $\chi^2_{12} = 50.1$, $P < 0.001$).

Socio-economic status (ANOVA: $F_{4,146} = 7.8$, $P = 0.001$) was different among communities with *post hoc* means comparison, showing that SES was lower for caregivers in Isidro Martinez compared with those from other communities. Educational attainment (chi-squared: $\chi^2_8 = 36.7$, $P = 0.001$) was also lower for caregivers in Isidro Martinez compared with those from the other communities. These results are consistent with findings regarding geographic distribution of poverty based on a national survey of health and demographics in the Dominican Republic (IEPD 1997). *Post hoc* means testing showed that SES was higher in Las Gordas where fewer fathers worked in agriculture, and caregiver education was somewhat higher compared with Isidro Martinez and La Meseta. Household size (ANOVA: $F_{4,146} = 3.9$, $P = 0.01$) and number of children under 18 years of age (ANOVA: $F_{4,146} = 10.0$, $P = 0.001$) were significantly different by province. *Post hoc* means testing showed that household size was higher in Isidro Martinez compared with three other communities. Age of caregiver, age of index child, and z -scores for height-for-age and BMI-for-age were not significantly different between communities.

Knowledge and attitudes

Knowledge of VA was consistently low among caregivers across all communities, with no statistical differences observed between communities (ANOVA: $F_{4,146} = 1.5$, $P = 0.19$) (Table 2). Only about half (55%) could identify a food that was thought to be a good source of VA, while 46% correctly selected a high-VA food from a list of five foods. The most common foods thought to be good sources of VA by caregivers were oranges (42%), milk (24%), cherries (16%), papaya (16%), eggs (15%) and mango (13%). The most commonly reported colour for foods considered to be good

Table 2. Demographic characteristics, vitamin A knowledge and practices by community*†‡

	Overall (<i>n</i> = 151)	Isidro Martinez, Elias Pina (<i>n</i> = 34)	La Meseta, San Juan (<i>n</i> = 26)	Los Hatillos, Hato Mayor (<i>n</i> = 29)	Las Gordas, Maria Trinidad Sanchez (<i>n</i> = 35)	La Angostura, La Vega (<i>n</i> = 27)	<i>P</i> -value by ANOVA or chi-squared
Grandmother as caregiver percentage (<i>n</i>)	28 (40)	27 (9)	40 (10)	30 (7)	27 (9)	19 (5)	0.55
Age of caregiver (years, mean ± SD)	38 ± 13	39 ± 14 ^a	41 ± 12 ^a	39 ± 15 ^a	36 ± 14 ^a	35 ± 11 ^a	0.46
SES (mean ± SD)	9.9 ± 2.5	8.3 ± 2.3 ^a	9.7 ± 2.3 ^b	10.5 ± 1.9 ^{bc}	11.3 ± 2.6 ^c	10.2 ± 2.4 ^{bc}	0.001
Education level percentage(<i>n</i>)							0.001
Never attended	16 (24)	38 (13)	15 (4)	17 (5)	0 (0)	11 (3)	
Primary school	57 (83)	53 (18)	69 (18)	55 (16)	43 (15)	70 (19)	
Secondary school/university	27 (39)	9 (3)	15 (4)	27 (8)	57 (20)	19 (5)	
Caregiver occupation percentage (<i>n</i>)							0.05
Homemaker	83 (125)	97 (33)	77 (20)	86 (25)	65 (22)	89 (24)	
Student or employed outside the home	17 (26)	3 (1)	23 (6)	14 (4)	35 (12)	11 (3)	
Age of index child (years, mean ± SD)	5.4 ± 1.9	4.8 ± 1.8 ^a	5.3 ± 1.8 ^a	6.0 ± 2.2 ^a	5.4 ± 1.9 ^a	5.7 ± 1.9 ^a	0.15
Height-for-age z-score for index child	-0.57 ± 1.21	-0.53 ± 1.40 ^a	-0.55 ± 1.29 ^a	-1.00 ± 1.33 ^a	-0.44 ± 1.01 ^a	-0.64 ± 1.19 ^a	0.50
BMI-for-age z-score for index child	-0.22 ± 1.11	-0.34 ± 1.20 ^a	-0.38 ± 0.95 ^a	-0.43 ± 1.46 ^a	0.10 ± 1.00 ^a	-0.19 ± 0.90 ^a	0.41
Occupation of father of index child percentage (<i>n</i>)							0.001
Agriculture	52 (79)	74 (25)	81 (21)	21 (6)	32 (11)	60 (15)	
Other employment	35 (50)	15 (5)	8 (2)	69 (21)	39 (14)	28 (9)	
Not present	9 (14)	12 (4)	8 (2)	7 (2)	12 (4)	8 (2)	
Unemployed	6 (8)	0 (0)	4 (1)	0 (0)	18 (6)	4 (1)	
Vitamin A knowledge of caregiver (mean ± SD)	1.6 ± 1.1	1.3 ± 1.1 ^a	1.8 ± 1.0 ^a	1.9 ± 1.1 ^a	1.7 ± 1.1 ^a	1.4 ± 0.9 ^a	0.19
Percentage of caregivers having a garden (<i>n</i>)	67 (102)	85 (29)	88 (23)	38 (11)	60 (21)	67 (18)	0.001
Percentage of caregivers owning animals (<i>n</i>)	72 (108)	85 (29)	85 (22)	41 (12)	68 (23)	81 (22)	0.001

*Mean values with different superscript letters across rows are significantly different according to Duncan's Multiple Range Test, $P < 0.05$. Chi-square analysis was conducted for categorical variables, $P < 0.05$. †Vitamin A knowledge = sum of points assigned for correctly identifying vitamin A-rich foods, colour of these foods, symptoms of VAD and identifying the best source of vitamin A from a list of foods (0–4 points possible). ‡SES = sum of points assigned for ownership of a radio, stove, oven and motorcycle/moped; land and home ownership; dwelling characteristics such as flooring and wall material and number of rooms (ranging from 0 to 16). BMI, body mass index; SES, socio-economic status; VAD, vitamin A deficiency.

sources of VA was yellow, while about one-third responded that they did not know. The most commonly reported symptoms of deficiency of VA were weakness (16%), anaemia (9%), loss of appetite (7%), cracked lips (6%) and some form of skin discoloration (6%), while 23% indicated that they did not know.

The five most commonly reported foods that would help the child grow were milk, beans, rice, starchy root vegetables and juice. Three-fourths of caregivers with children in school reported that children should be taught about health and nutrition issues (32%) and food safety (16%), while 34% did not have an opinion about what should be taught. Food safety issues included washing hands and food and cooking food well. Health and nutrition issues included general information about foods to eat for health and growth. About three-fourths of caregivers indicated that they teach their child about food safety, and foods needed for health. Only 14% of caregivers reported that the child had ever received VA supplements. About half of all caregivers reported that there were general benefits that could be derived from VA supplementation for the child, including strength, growth and energy.

A low percentage of caregivers (20%) reported receiving prior education about nutrition and health. Sources of education were aid organizations, healthcare facilities, women's groups, churches and schools. Most education was reported to pertain to health issues, such as hygiene, and prevention and treatment of diarrhoea and parasites.

Food-related practices

About two-thirds of the caregivers reported having a garden, ranging in size from less than 1 acre to 9 acres. Fewer reported having a garden in Los Hatillos, which was a peri-urban community compared with the other communities (chi-squared: $\chi^2_4 = 22.6$, $P = 0.001$) (Table 2). About one-third of the total reported not having land for a garden; one-third had less than 1 acre, and one-third had between 1 and 9 acres. Gardens were reported to be located in a patio (35%) or a parcel located farther from the home (55%). Water was reportedly available

for irrigation for 66%, and 55% reported that their garden was fenced. About 40% had purchased their land, while 38% had inherited the land from parents. A large proportion (about 60%) of caregivers reported that their husband prepared, tended and harvested the garden, with about 10% reporting that they completed these tasks. For those who did not have a garden, the most common reason was lack of land (77%), followed by lack of materials (67%), while most (84%) reported that they had the knowledge to plant and maintain a garden.

Perceived benefits from having a garden were mostly financial, with 66% reporting that having a garden saves money, while only 8% reported that benefits were related to health and dietary diversity. Many caregivers reported having animals (72%), with fewer in Los Hatillos (the peri-urban community) compared with the other communities (chi-squared: $\chi^2_4 = 20.0$, $P = 0.001$). The majority reported owning poultry (60%) and fewer owning cows (43%), pigs (23%) and rabbits (2%).

Fruit was acquired from several sources. A majority of the caregivers reported the garden as a source (53%) as well as the market (53%). Others reported getting fruit from street vendors (7%), small neighbourhood stores (7%), supermarkets (5%) or as a gift from others (9%). Fewer reported getting vegetables from a garden (15%) or small neighbourhood store (15%), while more acquired vegetables from a market (65%). In addition, some (13%) also reported getting vegetables from mobile vendors (trucks selling produce). Starchy root vegetables were mostly obtained from a garden by many caregivers (60%), from a market (39%) or small neighbourhood stores (17%). Caregivers reported that bananas and plantains were the most commonly grown fruits/vegetables in all five communities, except in La Vega, where tayota farmers outnumbered banana and plantain growers (tayota is a hard green pear-shaped fruit with a white pulp inside). Auyama (tropical squash), yuca (cassava), corn and pigeon peas were also commonly grown.

Reported consumption of VA-containing foods

Caregivers reported that mango was commonly consumed (58% on a daily basis) by children (Table 3).

Table 3. Frequency of consumption by the index child and associations with caregiver vitamin A knowledge, socio-economic status and education*†

Food	Consumption frequency (%)		
	High	Low	Never
Provitamin A carotenoid sources			
Cilantro ^c	78.8	15.2	6.0
Mango ^c	64.6	14.6	20.8
Peppers – long yellow ^b	63.6	24.5	11.9
Peppers – short ^b	52.7	20.6	26.7
Plantain – unripe ^b	47.0	43.1	9.9
Banana – unripe ^b	45.0	44.3	10.6
Auyama ^c	21.1	36.4	42.4
Ripe tomato ^a	19.7	60.6	19.7
Lettuce ^a	18.7	56.0	25.3
Plantain – ripe ^a	13.9	41.1	45.0
Carrot ^c	10.6	47.7	41.7
Rulo ^a	9.9	29.8	60.3
Watercress ^c	4.6	21.2	74.2
Melon ^b	2.0	18.8	79.2
Cantaloupe ^b	0.0	0.7	99.3
Yerbabuena ^c	0.0	14.6	85.4
Spinach ^c	0.0	11.9	88.1
Asparagus ^b	0.0	0.7	99.3
Preformed vitamin A sources			
Chicken liver ^c	8.0	22.7	69.3
Pork liver ^c	0.7	4.7	94.6
Beef liver ^c	0.0	13.3	86.7

*Consumption frequency: high = daily + 3–4 times per week responses; low = monthly + weekly responses; and never = never responses. †Vitamin A and precursor sources = ^a(20–40 µg); ^b(40–80 µg); and ^c(>80 µg).

At the time the data were collected, mango was in season. Cilantro was reportedly used by 59% on a daily basis, and 30% reported monthly use or more. Two types of peppers were also consumed frequently. While cilantro and peppers are good sources of VA, they are used in very small amounts as a seasoning. The platano verde (unripe plantain) and guineo verde (unripe banana) were consumed with fairly high frequency by children at 47% and 45%, respectively. Auyama, tomato and several other seasonal foods containing provitamin A carotenoids were also reported to be commonly consumed.

Discussion

The results of this study suggest that both individual factors, such as knowledge and attitudes, and envi-

ronmental factors, such as diversity of produce grown in home gardens, need to be addressed through nutrition education to prevent VAD in children. Knowledge of VA and VAD among caregivers in this sample was low; consistent with baseline and control findings from intervention studies conducted in South Africa, Nepal, Tanzania and India (Pokharel *et al.* 1998; Kidala *et al.* 2000; Faber *et al.* 2002; Jones *et al.* 2005). Addressing the low level of knowledge of VA and VAD is important because in these studies, greater maternal VA knowledge was associated with more frequent provision of VA-rich foods to children, producing positive long-term outcomes. For example, Pokharel *et al.* (1998) observed a reduction of risk for xerophthalmia among children of mothers who were able to identify VA-rich foods 2 years after participation in a nutrition education programme. Low VA knowledge may be expected due to lack of formal education about nutrition and health in developing countries. In our study, only 20% of caregivers reported receiving any previous formal education about nutrition and health. However, it should be noted that the VA knowledge score was based on questions about VA but did not include any specific probing regarding the local understanding of the concept of 'vitamin A'. While the term 'vitamin A' may have been commonly used in the communities where caregivers resided, it is not known how the meaning they attached to the term may have differed from that of nutrition professionals. For example, others have shown that caregivers in Honduras may have a different understanding of the term 'pneumonia' compared with medical terminology (Hudelson 1994).

In the current study, caregivers did not efficiently utilize home gardening to improve dietary diversity and provitamin A-rich vegetable and fruit consumption by children. Only a small number (8%) of caregivers were aware of this potential benefit, with many (66%) viewing home gardening as a source of income rather than a means to improve dietary diversity. A recent review of food-based strategies to address micronutrient malnutrition discussed similar observations in other developing countries (Tontisirin *et al.* 2002). Agricultural and food policies in these

countries tended to support primary agricultural production for financial gain, rather than home gardening and small livestock production for the explicit purpose of improving dietary diversity at the household level. Revenue from home-based garden produce sales did not necessarily result in greater purchasing or consumption of VA-rich foods (Marek *et al.* 1990; Jones *et al.* 2005), and often the need for additional income outweighs the motivation to derive nutritional benefits from home food production. Further study is needed to establish effective programmes to demonstrate the benefits of using home gardens for food and nutrition rather than exclusively for income. This will require additional study of household financial dynamics related to production and sales of produce from home gardens as well as purchases made with this revenue and its overall contribution to SES.

Community nutrition education programmes in developing countries are typically designed to foster changes in maternal knowledge and behaviour. It is thought that targeting mothers will have the largest impact on child nutrition and health because mothers spend more time caring for their children than other relatives (Gryboski 1996). However, recent studies have also demonstrated that grandmothers may play an important role in child nutrition and health. For example, grandmothers in Brazil exerted negative effects on duration and exclusivity of maternal breastfeeding (Susin *et al.* 2005), while the presence of maternal grandmothers in Gambian households improved nutritional status and survival of children (Sear *et al.* 2000). In Senegal, Aubel *et al.* (2004) found that mothers, husbands and other household members often solicited grandmothers' advice in matters of child health. In our study, mothers were more educated than grandmothers, but other informative variables were not significantly different between the two types of caregivers. Future nutrition education efforts should consider the value of grandmother support in effecting sustainable behavioural changes in mothers and children.

Effective nutrition education programmes should be specifically tailored to accommodate provincial differences that influence VA consumption by children, including economic barriers such as poverty,

employment and educational status of caregivers, and agricultural issues such as seasonality and growing conditions. Evidence exists for a relationship between maternal education attainment and risk for VAD in children and adolescents (Maleevong *et al.* 2004; Soekarjo *et al.* 2004), low intake of VA-rich foods (Ramakrishnan *et al.* 1999), and low height-for-age z-scores (Griffiths *et al.* 2004). In our study, VA knowledge was low among caregivers in all communities, regardless of differences in SES and educational attainment. The content of nutrition education regarding VA and VAD should be developed based on level of educational attainment. For example, where education attainment and SES were lowest, education programmes should focus on the fundamentals – foods that are good VA sources, colours of fruits and vegetables indicative of provitamin A carotenoids, and VAD symptoms – rather than on more advanced topics regarding recommended intake and bioavailability.

In this study, geography and seasonality limited what people were able to grow, buy and eat in some areas. La Angostura in La Vega, for example, is located far from markets and has poor access to some of the VA-rich foods that are consumed elsewhere. Also, because it is a mountain community, the high elevation prevents the growth of mango trees. Implications for nutrition education in isolated areas like La Angostura should involve promotion of provitamin A-rich vegetables, fruits and root crops appropriate to the locality. Opportunities to engage in home gardening and animal ownership practices that improve VA status are dependent on geography and availability of resources and will determine whether it is appropriate to promote these practices.

The purpose of this cross-sectional study was to assess nutrition education needs pertinent to caregiver VA knowledge, attitudes and practices; therefore, the study design did not allow for cause and effect relationships to be determined. Because multiple interviewers collected interview data, another limitation was the potential for interviewer effects on outcomes. To minimize this problem, interviewers were trained by research team members through guided practice, observation and critique.

Additionally, all interviews were supervised by at least one member of the research team to ensure consistency in interview procedures.

Based on this assessment study regarding nutrition education needs for caregivers from selected communities in the Dominican Republic, nutrition education should address knowledge of VA-rich foods and symptoms of VAD in children, as well as increasing the variety of foods rich in provitamin A carotenoids grown in home gardens and consumed at home. Education also needs to be tailored to education level of the caregiver and geographical location of the community.

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