Seasonal Dietary Stress in Peruvian Children

by Margaret A. Graham
Department of Anthropology and Sociology, Santa Clara University, CA 95053, USA

Summary
This article examines the seasonal variation in energy intake among young children in a farming community in southern Peru. Caloric intakes among young children fall to their lowest annual level during the post-harvest season even though food and cash resources are at their highest levels. Among toddlers (1–3 years) the decline is statistically significant ($p = 0.006$). Their energy intake meets only 65.6 per cent of their predicted requirement during the post-harvest season. In contrast to the literature, dietary stress for young children is not greatest in the pre-harvest season. Also, household food availability does not accurately indicate dietary risk among young children in this community.

Introduction
Studies of food consumption among small-scale farmers in less-developed countries describe a peak associated with the harvest and food scarcity during the pre-harvest season.$^{1,2}$ Previous studies in the Peruvian Andes have shown that energy intake follows the expected seasonal pattern; intake is higher during the post-harvest season than during the pre-harvest season for all age and sex groups.$^{3–6}$ This article focuses on the energy intake patterns of preschool children in a farming community in highland Peru.

Materials and Methods
The research took place in Ura Ayllu, an indigenous farming community located in the Quechua-speaking region of the Department of Puno. Its population of 706 is divided into 168 households; the average household size is 4.2 people. This nucleated settlement, at 3400 m above sea level, straddles a dirt road that links the Amazonian lowlands with the highland market towns of Juliaca and Puno. The village has no electricity but does have a piped water system. Cooking is done over kitchen fires fueled by wood, grass, leaves, and animal dung. Household members eat two or three meals a day together in the kitchen.

Most households engage in subsistence farming and other labor, primarily gold mining in the Amazonian lowlands. The diet is based on crops that are grown for consumption, not for sale, and include potatoes, oca ($Oxalis tuberosa$), fava beans, and corn. Landholdings in the community range from about 2800 m to about 3500 m above sea level. Every household cultivates a number of fields each year, and the average land area planted per household is small, just under half a hectare.$^{7}$ Most households augment their harvests with food bought with income from gold mining. From December to March, i.e. the pre-harvest season, most adult and adolescent males are absent from the community, mining for gold.

Fieldwork took place over 17 months and data were gathered on dietary intake (weighed food records), nutritional status (anthropometry), and local knowledge and practices relating to food, hunger, child development, and agriculture (participant observation, and informal and semi-structured interviews). Dietary data were collected within an annual agricultural cycle beginning with the first harvests in February 1986 and concluding in the pre-harvest month of January 1987. Food intake was measured during each of the three time periods, i.e. harvest, post-harvest, and pre-harvest. The dietary survey rounds (1, 2, and 3) are identified in relation to the agricultural cycle and corresponding months shown in Table 1.

Households were selected by random sampling (with replacement) of all village households (approximately 168). Each household included in the sample had at least one child between 6 and 59 months of age. The sample consisted of 15 households, representing 12 per cent of households with dependent children. The total number of individuals measured varied by season: 57 in the harvest phase and 75 in each the post- and pre-harvest phases. For analytical purposes, young children were divided into two age groups: toddlers (aged 1–3 years), and preschool children (aged 4–6 years). The average age was 2.25 for the toddler group ($n = 12$) and 4.93 for the preschool group ($n = 14$). Mean weight-for-age

Correspondence: Margaret A. Graham, Assistant Professor, Department of Anthropology and Sociology, Santa Clara University, Santa Clara, CA 95053, USA. Tel. (408) 551-1684; Fax (408) 554-4189 E-mail <mgraham@scu.edu>.

Scheduling of the dietary survey

<table>
<thead>
<tr>
<th>Dietary survey round</th>
<th>Agricultural season</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Harvest</td>
<td>late Feb.–early May, 1986</td>
</tr>
<tr>
<td>2</td>
<td>Post-harvest</td>
<td>late May–early Aug., 1986</td>
</tr>
</tbody>
</table>

a Planting (tarpuy) took place between dietary survey rounds 2 and 3 in August and September.

z-scores (WAZ) were –1.37 for toddlers and –1.11 for the preschool children. Mean height-for-age z-scores (HAZ) were –2.735 for toddlers and –2.235 for the preschool children. Z-scores were calculated to the age- and sex-specific standards (NHANES I and II) provided in Frisancho.8

To collect dietary data, the author attended food preparation and meal consumption for one day for each of the three seasons. Each ingredient for a meal was weighed prior to cooking, and then, when the meal was served, each individual’s portion of cooked food was weighed.9 Plate waste and leftovers were weighed and subtracted from the total weight of the served portions. A temperature-compensated top-loading spring Homs scale, graduated in 2-g increments, was used to weigh the food and containers.

While the food-weighing technique also recommends collecting data on foods eaten outside the home, recall data were vague and imprecise (due to people’s unfamiliarity with the method) and were judged unreliable for analytical purposes. It was impossible for the researcher to follow all household members throughout a single day because, following local practice, household members disperse after meals to work in fields that lie far apart. The dietary analyses therefore included foods eaten during meals and meal preparation. Overall, 7–9 h/day were spent with each household to weigh food and observe meal preparation and consumption.

Random spot-checks of meals were performed on some of the sample households without warning on ‘non-weighing’ days to observe the kinds of foods being prepared and eaten and the number of household members present. These visits were used as reliability checks on the intake data collected during the weighing visits.

Food weights were converted to nutrient values with the use of food composition tables published for the Andean region and Latin America.10–12 The conversion of individual food weights to nutrient values were calculated using spreadsheets (Lotus 123 and Excel). Statistical analyses of data were performed using SYSTAT 4.1 program.

Observed energy intakes were compared to predicted the caloric requirements specific to highland Andean populations, following Leonard.13

Results

Energy intakes

A comparison across the seasons of mean daily kilocalorie intakes of different segments of the population [children, adult women (females at least 20 years of age), and the entire sample (per capita intake)] is shown in Table 2. In all categories, caloric intakes were lowest during the post-harvest season (round 2). The post-harvest decline was most dramatic, however, among children. The absolute difference in calorie intake between rounds 1 and 2 was greater for children than for women or for the sample taken as a whole: 328 kcal for toddlers, 313 kcal for preschool children, 44 kcal for women, and 90 kcal for the entire sample. One-way analysis of variance performed on energy intake by season in both groups of children indicated statistically significant differences in calorie intake by round for the toddler group (F = 6.013, p = 0.006). Energy consumption among preschool children did not differ significantly by round (F = 1.882, p = 0.167).

Energy adequacy

A comparison of the observed energy intakes and the predicted energy requirements is shown in Table 3. Children’s caloric intakes exceeded the predicted requirement in both the harvest and pre-harvest seasons. During the post-harvest season, however, energy intakes fell below the predicted requirement, especially among the toddlers. Energy intakes at that time represented only 65.5 per cent of their estimated requirement. In contrast, the preschool group’s intake fell short of the estimated requirement by only 5 per cent. The data indicate that toddlers were meeting their predicted energy needs for much of the year, but not during the post-harvest season of plenty.

Discussion

Previous studies in the Andes indicated that energy intakes reflect the seasonal availability of food and cash (to purchase food) and that they are greatest during the harvest and post-harvest seasons and lowest during the pre-harvest season. Energy consumption of toddlers in Ura Ayllu inverts this predicted trend. The mean energy intake of young children fell to its lowest annual level precisely at the time when it was expected to be highest. Energy intakes during the post-harvest season were 57 per cent of those during the harvest (round 1) for toddlers and 73 per cent for preschool children (round 2 intake/round 1 intake). In contrast, energy...
intakes during round 3 (pre-harvest) were 89 per cent of the intake during round 1.

Increased between-meal eating may counterbalance some of the toddlers’ low energy intakes recorded in this study during the post-harvest season. Using the child-following method in rural Mexico, researchers found that snacking contributed 45 per cent of calories to the daily energy intake of children (aged 33–60 months) in the harvest season (August–October).14 If similar patterns of food consumption were practiced in Ura Ayllu, it might mean that toddlers are not as undernourished as they seem. On the other hand, the children in the Mexican study were older and would have been able to come and go more freely and to gain access to food more efficiently than the toddlers in this study. Future research should examine the contribution of between-meal consumption to young toddlers’ energy intakes in communities like Ura Ayllu.

The reduction in the post-harvest intake relative to the harvest season is experienced by most toddlers and is not limited to just a few individuals who are lowering the group mean. Among toddlers, 83 per cent (10 of 12) ate fewer calories during round 2 than they did in round 1; two consumed more calories than in the previous measurement round. Similarly, among 4–6-year-olds, 85 per cent (11 of 13) ate fewer calories during the post-harvest round than they did during the harvest period. The decline in intake was widespread among the children and did not appear to be a statistical artifact.

Comparing the harvest season (round 1) to the pre-harvest season (round 3), when intakes are expected to decline, 58 per cent (seven of 12) experienced a decline in intake during the pre-harvest period relative to the harvest (round 1). Forty-two per cent (five children) showed higher caloric intakes during the pre-harvest season compared to the harvest season. Among the preschool group, eight (67 per cent) had a decline while four (33 per cent) had an increase in intake. These data indicate that a greater proportion of

---

**Table 2**

Comparison of mean energy intakes by season (average kilocalorie intake ± SD)

<table>
<thead>
<tr>
<th>Age group</th>
<th>Round 1 (harvest)</th>
<th>Round 2 (post-harvest)</th>
<th>Round 3 (pre-harvest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toddlers (1–3 years)</td>
<td>769 ± 259</td>
<td>441 ± 235</td>
<td>689 ± 229</td>
</tr>
<tr>
<td>(n)</td>
<td>(12)</td>
<td>(12)</td>
<td>(12)</td>
</tr>
<tr>
<td>Preschool children (4–6 years)</td>
<td>1179 ± 398</td>
<td>866 ± 461</td>
<td>997 ± 394</td>
</tr>
<tr>
<td>(n)</td>
<td>(13)</td>
<td>(14)</td>
<td>(13)</td>
</tr>
<tr>
<td>Adult womena</td>
<td>1654 ± 427</td>
<td>1610 ± 603</td>
<td>1653 ± 483</td>
</tr>
<tr>
<td>(n)</td>
<td>(16)</td>
<td>(16)</td>
<td>(16)</td>
</tr>
<tr>
<td>Overall per capita intakeb</td>
<td>1335 ± 575</td>
<td>1245 ± 675</td>
<td>1351 ± 599</td>
</tr>
<tr>
<td>(n)</td>
<td>(57)</td>
<td>(75)</td>
<td>(75)</td>
</tr>
</tbody>
</table>

a Includes all adult women (≥ 20 years of age). n represents 15 mothers and one mother-in-law with whom one mother and her family reside.

b Per capita intake is average energy intake for the entire sample. The average age of the sample is 14 years in round 1 and 16 years in rounds 2 and 3.

**Table 3**

Comparison of observed energy intakes to predicted energy requirements

<table>
<thead>
<tr>
<th>Age group</th>
<th>Sex</th>
<th>Predicted kcal requirementa</th>
<th>Round 1 (harvest)</th>
<th>Round 2 (post-harvest)</th>
<th>Round 3 (pre-harvest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–3 years</td>
<td>M &amp; F</td>
<td>673</td>
<td>769 (114%)</td>
<td>441 (65.5%)</td>
<td>689 (102%)</td>
</tr>
<tr>
<td>4–6 years</td>
<td>M &amp; F</td>
<td>910</td>
<td>1179 (130%)</td>
<td>866 (95%)</td>
<td>997 (110%)</td>
</tr>
<tr>
<td>Adults</td>
<td>F</td>
<td>1798b</td>
<td>1654 (92%)</td>
<td>1610 (89%)</td>
<td>1653 (92%)</td>
</tr>
</tbody>
</table>

a Total predicted kcal requirement is the sum of the resting metabolic rate and amount of energy expended in daily activities following Leonard.13

b Total includes energy costs of pregnancy and lactation.
children experience a decline of energy intake during the months when food is readily available (round 2) than when food stores are diminished (round 3).

The post-harvest decline among toddlers is statistically significant. According to the food-weighing method, they consume on average only 65 per cent of their predicted energy requirement, which suggests that these children are experiencing considerable energy stress at this time of year. The finding that young children experience energy stress during periods of food abundance underscores the need to examine the social and behavioral factors that influence food distribution to toddlers. Household food availability is not necessarily a good indicator of individual food intake.

Ethnographic data on hunger in the community do not predict the season of greatest food scarcity for toddlers. According to the mothers in this study, the post-harvest season is not a time of food stress. They say dietary stress occurs during the pre-harvest months when local food supplies and cash resources are diminished or depleted.

The post-harvest season is a busy one in Ura Ayllu. Dry climatic conditions and the return of the gold-mining migrants allow families to engage in a wide range of activities, such as field preparation for planting, the collection of dry cooking fuels, and house repair. The level of activity may divert mothers’ attention away from individual household members’ food needs. It is possible, then, that the post-harvest season is a period of energy stress for toddlers that women may not consciously recognize.

References