

# NUTRITIONAL ANTHROPOMETRY AND DIETARY INTAKE OF CHILDREN FROM THE LAS CUEVAS REGION OF THE DOMINICAN REPUBLIC

*Linda Bruce<sup>1</sup> and Leslie Sue Lieberman<sup>2</sup>*

University of Florida  
Gainesville, Florida

## SUMMARY

A nutritional survey was conducted in the "Las Cuevas" watershed located in the southwestern region of the Dominican Republic to assess the nutritional status of preschool children. Height, weight, mid-arm circumference and triceps skinfold measurements were taken of 280 children between 6 to 54 months of age. Dietary recall was elicited from mothers or care givers. Results compared with the National Center for Health Statistics reference data indicate that these children: 1) experience growth failure and poor nutritional status as indicated by low weight for age; 2) suffer chronic malnutrition as revealed by low height for age and reduced muscle mass of the mid-arm; and 3) have appropriate weight for height measurements.

A food frequency survey revealed that these children consume a diet high in carbohydrates and low in animal protein. Breast feeding is a common practice although cow's milk was introduced early in 25% of the sample. The mean age at weaning is 12 months. The results indicate that these children experience the greatest growth deficits in the second year of life and that these deficits are indicative of chronic undernutrition rather than acute food shortage or recent disease episodes.

This study was carried out to establish baseline data for a resource management project initiated by the Secretariat of Agriculture of the Dominican Republic.

## INTRODUCTION

Malnutrition is one of the Dominican Republic's major health problems. This condition is acute in children under five years of age who make up 43.1% of the country's six million inhabitants. According to a

---

Manuscrito modificado recibido: 16-1-87.

<sup>1</sup> Department of Food Science and Human Nutrition, University of Florida, Gainesville, Florida 32611. Present address: 3001 Veazey Terrace, N.W. No. 923, Washington, D.C. 20008, USA.

<sup>2</sup> Department of Anthropology and Pediatrics, University of Florida, Gainesville, Florida 32611.

nutritional survey undertaken in 1969 among lower and middle income families, 75% of the children comprised between the ages of one to five years suffered from protein-energy malnutrition (PEM) (1). Subsequent surveys revealed similar findings. In a 1976 study of the Catholic Relief Services (CARE) conducted in the central and southwestern regions of the Dominican Republic, 66% of the preschool children were malnourished (2). More recently, in 1981, a nutrition survey was carried out by the Secretariat of Public Health, in the rural area surrounding La Romana located in the eastern region of the Island. Data for 849 children under one year of age indicated that 41% were diagnosed as malnourished, although only 1.9% were classified as severely malnourished (3). All survey results were compared to the Gómez classification, which measures the degree of PEM according to the percentage deficit in weight for age.

Little research has been conducted in the rural southwestern region of the Dominican Republic which consists primarily of small land holders and tenant farmers and is considered a frontier zone. Previous estimates suggest that childhood PEM is worse in the southwest, but these data include an urban coastal population (3). Therefore, the "Las Cuevas" watershed was the site selected for another nutritional survey undertaken to assess the nutritional status of this rural mountainous region. A second purpose was to compare results with previous data in order to determine if there had been any improvement in the nutritional status of Dominican children since the first 1969 survey.

The survey was conducted in the summer of 1982 as part of an interdisciplinary research project initiated by the Secretariat of Agriculture of the Dominican Republic and the Center for Latin American Studies of the University of Florida. The main purpose of the "Las Cuevas" project was to improve resource management in an underdeveloped rural region of the country and to train professionals to conserve natural resources (4). At the initiation of the "Las Cuevas" project, nutritional status of the population was taken to provide baseline data for assistance programs (4).

The "Las Cuevas" watershed is located on the southwestern flank of the Cordillera Central and covers 600 km<sup>2</sup>. In 1981 the estimated population was 31,148 inhabitants, with an average density of 52 persons per km<sup>2</sup>. The population of "Las Cuevas" is 71% rural (4), most of the inhabitants being small-farm agriculturists who cultivate land and tend goats. In the same year of 1981, family income in the region was estimated to be less than US\$800.00 annually (4). Mortality in the watershed is difficult to calculate due to the absence of accurate records. Although the stated mortality rate for the province of Azua is 4.5/1,000 (37/1,000 for the Dominican Republic) (5), it is suspected that this rate is considerably underestimated.

#### MATERIAL AND METHODS

The sample population was comprised by 10% of the children from six to 54 months of age in every community in the watershed, accessible by four wheel-drive vehicles. Households with preschool children were

randomly selected, and were either measured at home or brought to a meeting place for this purpose and for interviews with their mothers. A total of 280 children, 141 males and 139 females were measured. The preschool children population for each community was determined by statistics from the Department of Rural Health and from the rural health agent (6).

Anthropometric measurements were taken to determine nutritional status based on the National Center for Health Statistic's (NCHS) age and sex specific reference data for weight, height, arm circumference and triceps skinfold. (7-12). From these measurements, relationships of weight for age, height for age, weight for height and the fat and muscle areas of the upper arm were derived. Weight was measured with a hanging scale hung from a stable pole or fixture, removing clothes and shoes except underwear before weighing. Weights were recorded in kilograms to the nearest tenth. Height was measured by recumbent length to the nearest tenth of a centimeter on a 100 cm. length board. Recumbent length gives a slightly larger measurement than standing length. The difference between the two measurements is approximately one centimeter (9). The NCHS data report recumbent length for children birth to 36 months and stature for children 2-18 years (7).

Upper arm circumference was measured at the midpoint between the acromion process of the scapula and olecranon process of the elbow at the posterior midline over the belly of the triceps. A fiber glass, non-stretchable tape was used to measure the circumference. Measurements were recorded in centimeters to the nearest 0.1 centimeter. Triceps skinfold, a measure of a double layer of skin and subcutaneous fat on the midpoint of the upper arm, was taken with an Adiameter<sup>T</sup> skinfold caliper. Measurements were recorded to the nearest millimeter. Using both skinfold and upper arm circumference the cross-sectional area of fat and muscle was calculated in order to determine the relative tissue of the upper arm (8, 10, 12).

The National Center for Health Statistics (NCHS) reference data were used to evaluate the anthropometric data collected in "Las Cuevas". Considering that well-fed ethnic groups have reached similar growth standards as well-nourished Caucasians in the United States and Europe, the NCHS tables were used as a reference to assess growth deviations of the "Las Cuevas" children (11). Upper arm circumferences, tricep skinfolds and the derived tissue circumferences and areas were compared to the National Health and Nutritional Examination Survey I (NHANES I) standards. This reference includes children from one to five years of age (12, 13).

Food frequency data were collected for 90% of the children surveyed. Each mother was interviewed by a Dominican interviewer to determine food frequency consumption, breast-feeding practices and weaning foods. No attempt was made to quantify food eaten, determine standard composition, or calculate nutritive values. Food frequency was taken so as to obtain a general dietary profile.

## RESULTS

According to the weight-for-age measurements, 23% of the children

were at, or below the 5th percentile. Over 60% of them did not achieve weights over the 25th percentile, while only 21% of the children were above the 50th percentile (Table 1). Males tended to have lower weights than females. For all ages, nearly 30% of males were at or below the 5th percentile, while less than 20% of females were in this category. The children who showed the greatest deficits in weights belong to the age range of 12 to 23 months old. Twenty-nine of the total 104 children in this age group were at or below the 5th percentile.

As to measurements for height for age, these indicate that 39% of the sample were at, or below the 5th percentile. Over 70% of the children did not exceed the 25th percentile (Table 1). A small 17% were above the 50th percentile, males generally being of shorter stature than their female counterparts. More than 40% of the males were at the 5th percentile, while 35% of the females were in this category. Children from 24 to 35 months of age experience the greatest deficits for age.

Children in the "Las Cuevas" watershed did not experience great deficits in weight for height. Fewer than 8% of the children were at or below the 5th percentile (Table 1). As the data reveal, a little over 50% of the children were above the 50th percentile, which is to be expected in a normal centile distribution.

Both upper arm circumference and triceps skinfold measurements of the sample were low when compared to the NCHS reference data. As may be observed, over 30% of the subjects were at or below the 5th percentile, while over 70% did not exceed the 25th percentile (Table 2). A mere 12% were above the 50th percentile. Triceps skinfold thickness was equally low in the sample; while 16% of the children were at or below the 5th percentile, only 13% of them were above the 50th percentile.

Calculated from upper arm circumference and skinfold thickness, the fat area of the sample was low. Nearly 60% of the sample had fat areas at or below the 25th percentile, while less than 20% exceeded the 50th percentile. Calculated muscle area shows approximately 57% of the children with reduced muscle mass, falling at or below the 25th percentile. Only 20% of the sample were greater than the 50th percentile (Table 2).

According to the dietary survey, the customary diet consists primarily of high carbohydrate foods: rice, bread and spaghetti as well as starchy tubers such as yucca, potatoes, and plantains comprise the daily fare. Beans (habichuelas, gandules, etc.), which are grown locally, are also consumed on a daily basis. The main sources of animal protein, milk and eggs, are consumed daily by 50% of the children. Meat, chicken, fish and goat are eaten from one to three times a week to once a month. Fruits and vegetables are not an integral part of the diet. Except for the small banana, guineo, fruits and vegetables are consumed once or twice a week at the most. The consumption of fruit, however, may have been under-reported since mothers were not questioned about their children consuming seasonal fruits such as mangoes, which are picked from the trees and eaten as snacks. Condiments, peanut oil, sugar, as well as coffee and tea are usually part of every meal.

Breast feeding is a common practice in the Dominican Republic. According to the dietary survey, 60% of the mothers breast-fed their

TABLE 1

CENTILE DISTRIBUTION OF WEIGHT FOR AGE, HEIGHT FOR AGE  
AND WEIGHT FOR HEIGHT BY SEX

Percentile rank of NCHS standard <sup>1</sup>	Female <sup>2</sup>	(No.)	Male	(No.)	Total	(No.)
<b>Weight</b>						
5 or less	19 <sup>o</sup> /o	(26)	29 <sup>o</sup> /o	(40)	24 <sup>o</sup> /o	66
10-24	37 <sup>o</sup> /o	(52)	37 <sup>o</sup> /o	(51)	37 <sup>o</sup> /o	103
25-50	17 <sup>o</sup> /o	(24)	17 <sup>o</sup> /o	(24)	17 <sup>o</sup> /o	48
51 or more	26 <sup>o</sup> /o	(36)	16 <sup>o</sup> /o	(23)	21 <sup>o</sup> /o	59
<b>Height</b>						
5 or less	35 <sup>o</sup> /o	(49)	43 <sup>o</sup> /o	(61)	39 <sup>o</sup> /o	110
10-24	35 <sup>o</sup> /o	(49)	30 <sup>o</sup> /o	(42)	32 <sup>o</sup> /o	91
25-50	12 <sup>o</sup> /o	(17)	10 <sup>o</sup> /o	(15)	11 <sup>o</sup> /o	32
51 or more	17 <sup>o</sup> /o	(24)	16 <sup>o</sup> /o	(23)	17 <sup>o</sup> /o	47
<b>Weight for height</b>						
5 or less	8 <sup>o</sup> /o	(11)	9 <sup>o</sup> /o	(13)	8 <sup>o</sup> /o	24
10-24	17 <sup>o</sup> /o	(24)	25 <sup>o</sup> /o	(35)	21 <sup>o</sup> /o	59
25-50	19 <sup>o</sup> /o	(27)	25 <sup>o</sup> /o	(35)	22 <sup>o</sup> /o	62
51 or more	55 <sup>o</sup> /o	(76)	40 <sup>o</sup> /o	(55)	47 <sup>o</sup> /o	131

1 National Center for Health Statistics (7).

2 Percentages may not equal 100<sup>o</sup>/o, due to rounding off.

children, a practice that lasts from 6 to 24 months. The mean weaning age was 12 months. Twenty-five per cent of the babies received cow's milk, and 10<sup>o</sup>/o formula. Whether or not some mothers combined breast-feeding with formula was not explored.

The average age for introducing solid foods was 6-7 months. In some cases children were not introduced to solid foods until they were 12 months old. The most severe cases of malnutrition were found among those children who were not given solid foods until 16 to 24 months of age. They continued breast-feeding often in competition with another sibling.

The most frequent weaning foods are variations of the daily diet. Rice, pureed tubers and beans along with plantains, guineo and coffee are the most common introductory foods. Sources of protein such as cow's milk, eggs, stewed meat and breast milk complement the infant's diet.

## DISCUSSION

Based on weight for age the children in "Las Cuevas" experience significant growth failure and poor nutritional status. As can be gleaned from the data nearly a quarter of the children do not surpass the 5th percentile

TABLE 2

## PRESENTATION OF CENTILE DISTRIBUTION OF ARM CIRCUMFERENCE, SKINFOLD THICKNESS AND FAT AND MUSCLE AREAS BY SEX

Percentile rank of NCHS standard <sup>1</sup>	Female <sup>2</sup>	(No.)	Male	(No.)	Total	(No.)
<b>Arm circumference</b>						
5 or less	33 <sup>o</sup> /o	(40)	38 <sup>o</sup> /o	(48)	36 <sup>o</sup> /o	88
10-24	33 <sup>o</sup> /o	(41)	34 <sup>o</sup> /o	(42)	34 <sup>o</sup> /o	83
25-50	20 <sup>o</sup> /o	(25)	15 <sup>o</sup> /o	(19)	18 <sup>o</sup> /o	44
51 or more	13 <sup>o</sup> /o	(16)	12 <sup>o</sup> /o	(15)	12 <sup>o</sup> /o	31
<b>Skinfold thickness</b>						
5 or less	14 <sup>o</sup> /o	(17)	17 <sup>o</sup> /o	(22)	16 <sup>o</sup> /o	39
10-24	39 <sup>o</sup> /o	(48)	40 <sup>o</sup> /o	(50)	40 <sup>o</sup> /o	98
25-50	34 <sup>o</sup> /o	(42)	28 <sup>o</sup> /o	(35)	31 <sup>o</sup> /o	77
51 or more	12 <sup>o</sup> /o	(15)	14 <sup>o</sup> /o	(17)	13 <sup>o</sup> /o	32
<b>Fat area</b>						
5 or less	11 <sup>o</sup> /o	(13)	15 <sup>o</sup> /o	(17)	12 <sup>o</sup> /o	30
10-24	49 <sup>o</sup> /o	(60)	45 <sup>o</sup> /o	(56)	47 <sup>o</sup> /o	116
25-50	22 <sup>o</sup> /o	(27)	21 <sup>o</sup> /o	(26)	21 <sup>o</sup> /o	53
51 or more	18 <sup>o</sup> /o	(22)	19 <sup>o</sup> /o	(23)	18 <sup>o</sup> /o	45
<b>Muscle area</b>						
5 or less	18 <sup>o</sup> /o	(22)	19 <sup>o</sup> /o	(23)	18 <sup>o</sup> /o	45
10-24	39 <sup>o</sup> /o	(47)	40 <sup>o</sup> /o	(50)	39 <sup>o</sup> /o	97
25-50	23 <sup>o</sup> /o	(28)	20 <sup>o</sup> /o	(25)	21 <sup>o</sup> /o	53
51 or more	20 <sup>o</sup> /o	(24)	21 <sup>o</sup> /o	(26)	20 <sup>o</sup> /o	50

1 National Center for Health Statistics (7).

2 Percentages may not equal 100<sup>o</sup>/o, due to rounding off.

in weight and more than 60<sup>o</sup>/o of them do not reach the 50th percentile. Males in particular, tend to be lighter than females. These low weights appear to be the result of decreased body fat, poor muscle development, deficient skeletal growth or a combination of all three. Height for age, weight for height, arm circumference and skinfold thickness will evaluate the degree of malnutrition as expressed by these low body weights.

For the purpose of this study, deviations in weight for age are evaluated according to the NCHS standard of reference. The Gómez Classification, frequently used for evaluating malnutrition in Latin America and the Caribbean, was not used because it does not take into account edematous weight nor distinguish between acute and chronic PEM. For comparison sake, however, the authors have also compared the "Las Cuevas" children to this classification. According to the Gómez standard, 52<sup>o</sup>/o of the sample suffered from 1st degree malnutrition, 17<sup>o</sup>/o from 2nd degree malnutrition, and 2<sup>o</sup>/o experience 3rd degree.

Low height for age reflects a prolonged period of nutritional stress and subsequent retardation of linear growth (11). This is an important measure to distinguish present day, from past nutrition. Due to the fact that height cannot be gained in a short period, significant deficits in height indicate a period of prolonged undernutrition. Height-for-age measurements for the "Las Cuevas" sample revealed children who were very short for their ages. Nearly two-thirds of the sample did not exceed the 25th percentile. This low stature was found among all age groups, but is particularly low after 24 months of age. The low height for age indicates a retardation of linear growth especially after the weaning age. The height/age data demonstrate that these children have suffered a history of malnutrition and retarded growth.

A deficit in weight for height disregarding age suggests that a child currently is, or has been in the period immediately prior to examination, on an inadequate diet (13). Nevertheless, a recent work by Cole (14) on the weight-for-height standard and by Rolland-Cachera *et al.* (15) on adiposity indices in children, suggest that weight for height may overestimate the proportion of children who are undernourished. The overestimation is greatest for children at the extremes of the distribution, i.e., those under the 5th centile and over the 95th centile and for all children at about two years of age. Unexpectedly, weight-for-height measurements are not particularly low for the "Las Cuevas" children. Only 8% of the subjects were below the 5th percentile, while over 65% were at or above the 50th percentile. This means that only a small percentage of the subjects were suffering from acute malnutrition. One explanation of the favorable weight-for-height measurements may lie in the fact that the sample was measured during the summer months, when crops were being harvested and food was more plentiful. For whatever reason, however, the weight-for-height ratio suggests that the children did not experience unusual nutritional stress before or during the survey.

Upper arm measurements are valuable indicators of nutritional reserves (10, 12, 13). A decreased amount of subcutaneous fat and poor muscle development or "muscle wasting" are cardinal features of all forms of protein-calorie malnutrition. Arm measurements for the "Las Cuevas" subjects indicated reduced protein reserves. Over 30% of the children had upper arm circumferences at or below the 5th percentile. Calculated muscle area revealed decreased muscle size, a sign of poor muscle development and decreased protein reserves. This phenomenon usually occurs from chronic calorie deprivation as revealed by low height for age. Skinfold thickness and estimated fat area indicate only moderately low fat reserves. Moderate deficits in fat storage may reflect an overall thinness but no acute deprivation of calories. Thus, the low arm circumference measurements appear to be a result of poor calorie and protein reserves rather than an acute deficit in calories.

The diet of the "Las Cuevas" children evidently was high in carbohydrates, and relatively low in protein. Starchy items such as rice, bread, tubers and plantains were consumed daily. Although milk and eggs are eaten daily by 50% of these children, beef, fish, and goat were consumed from two to three times a week at most. This diet may be one of the contributing factors related to the poor nutritional status in the watershed. Insufficient calorie consumption is reflected in low weight for age, and

low protein intake is shown by poor muscle development, low weight and retarded linear growth experienced by the children. This seemingly high carbohydrate, low-protein diet does not provide sufficient calories and nutrients to support proper growth and development as reflected by the poor nutritional status of the children in "Las Cuevas".

#### ACKNOWLEDGEMENT

This research was supported by a grant from the Dominican Republic Secretariat of Agriculture to Gustavo Antonini, Ph.D., Professor of Latin American Studies at the University of Florida.

#### RESUMEN

##### ANTROPOMETRIA NUTRICIONAL E INGESTA DIETETICA DE NIÑOS DE LA REGION "LAS CUEVAS" DE LA REPUBLICA DOMINICANA

Se llevó a cabo un estudio nutricional en la cuenca de "Las Cuevas", localizada en la región suroeste de la República Dominicana, con el propósito de analizar el estado nutricional de los niños de edad preescolar. Se hicieron mediciones de estatura, peso, circunferencia braquial y pliegue cutáneo del tríceps de 280 niños comprendidos entre las edades de 6 a 54 meses. Sus antecedentes alimentarios fueron recabados de sus madres o encargados.

Los resultados se compararon con datos de referencia del Centro Nacional de Estadísticas de Salud, los cuales revelaron: 1) que los niños experimentan un retardo de crecimiento y estado nutricional deficiente, indicado por un bajo peso para su edad; 2) que los niños sufren desnutrición crónica, como lo reveló la baja estatura para su edad y masa muscular reducida del antebrazo; y 3) que los niños tienen un peso adecuado para su estatura.

Un estudio de la frecuencia de alimentación demostró que los niños consumen una dieta rica en carbohidratos y baja en proteínas de origen animal. La lactancia materna es práctica común, aunque la leche de vaca se introdujo tempranamente en el 25% de los niños. La edad para la ablactación es de 12 meses.

Los resultados señalan, asimismo, que los niños experimentan los mayores déficits de crecimiento en el segundo año de vida, y que esos déficits son ocasionados por la malnutrición crónica, y no por la carencia aguda de alimentos ni por episodios recientes de enfermedad. El estudio se llevó a cabo con miras a establecer datos básicos requeridos para un proyecto de manejo de recursos iniciado por la Secretaría de Agricultura de la República Dominicana.

#### BIBLIOGRAPHY

1. Sebrell, W.H., K.W. King, R.E. Webb et al. Nutritional status of middle and low income groups in the Dominican Republic. *Arch. Latinoamer. Nutr.*, 22:1-90, 1972.
2. Suero, V.C. *La Desnutrición Infantil Según Dos Encuestas*. Santo Domingo, CARITAS, 1976.
3. Rondon, H. La Romana, Dominican Republic In: *Current Topics in Nutrition*

- and Disease. Vol. 10. **Malnutrition: Determinants and Consequences**. P.L. White and H. Slevey (Eds.) New York, N.Y., Alan R. Liss, 1984, p. 373-377.
4. Antonini, G.A. **Integrated Training and Research Program in Natural Resource Management for the Dominican Republic with Special Attention for "Las Cuevas" Watershed**. Gainesville, Fla., Center for Latin American Studies, 1981, p. 1-20.
  5. **Statistical Abstract of Latin America**. Los Angeles, University of California, Latin American Center Publication 22, Table 709.
  6. Government of the Dominican Republic. **Census Data from the Secretariat of Public Health**, Santo Domingo, 1982.
  7. National Center for Health Statistics. **NCHS Growth Charts. Monthly Vital Statistics Report**, 25:76-1120, 1976.
  8. Malina, R.M. The measurement of body composition. In: **Human Physical Growth and Maturation: Methodologies and Factors**. F.E. Johnston Roche and C. Susanne (Eds.). New York, N.Y., Plenum Press, 1980, p. 35-39.
  9. Tanner, J.M., R.H. Whitehouse & M. Takaishi. Standard from birth to maturity for height, weight, height velocity and weight velocity: British children. **Arch. Dis. Childhd**, 41:454-474, 1965.
  10. Gurney, J.M. & D.R. Jelliffe. Arm anthropometry in nutritional assessment: Nonogram for rapid calculation of muscle circumference and cross-sectional muscle and fat areas. **Am. J. Clin. Nutr.**, 26:912-915, 1973.
  11. Habicht, J-P., R. Martorell, C. Yarbrough, R.M. Malina & R.E. Klein. Height and weight standards for preschool children: How relevant are ethnic differences in growth potential? **Lancet**, 1:611-615, 1974.
  12. Frisancho, R.A. New norms of upper limb fat and muscle areas for assessment of nutritional status. **Am. J. Clin. Nutr.**, 34:25-40, 1981.
  13. Seone, N. & M.C. Latham. Nutritional anthropometry in the identification of malnutrition in childhood. **J. Trop. Pediat. Environ. Child Health**, 17:98-103, 1971.
  14. Cole, T.J. A critique of the NCHS weight-for-height standard. **Human Biology**, 57:183-196, 1985.
  15. Rolland-Cachera, M.F., M. Sempé, M. Guillaud *et al.* Adiposity indices in children. **Am. J. Clin. Nutr.**, 36:178-184, 1982.