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BULLETIN OF RESEARCH ABSTRACTS

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Inside this issue:

Editorial

The integration and transformation of the "Latin" in Latin American nutrition

This year offers the revival of a triennial ritual in the gathering of nutritionists, dieticians, food scientist and physicians from across Latin America at the Latin American Congress on Nutrition of the Latin American Nutrition Society (SLAN) that will be held in Havana, Cuba in November, 2012. It will be the XVI Congress, the 10th since the founding of CeSSIAM, the 13th since my own first attendance in Caracas in 1976. CeSSIAM really became a part of the SLAN scene, again in Venezuela, in 1991. Guatemala was the host nation, during the Presidency of **Hernán Delgado**, in 1997. I served as a member of the Scientific Committee for that event. That year marked another landmark, with the first Nutrition Leadership Program workshop for Latin America as a satellite meeting in Antigua Guatemala. In each of the subsequent Congress years, at least one member of CeSSIAM has been among the "young leaders" attending the LANLP: **Brenda Barahona** and **Paquita Farfán** (2000, Buenos Aires, Argentina); **Claudia Nieves, Mónica Orozco** and **Ingrid Ventura** (2003, Acapulco, Mexico); **Gabriela Montenegro** (2006, Florianopolis, Brazil); and **María Jose Soto-Méndez** (2009, Santiago, Chile). CeSSIAM as a group had robust participation in Mexico and Brazil.

Returning to the title of the Editorial, I would further comment on the connotation of "Latin" in the context of the nutrition community of the region. It was the two monarchies of the Iberian Peninsula – Spain and Portugal – whose colonization of the Western Hemisphere gave the linguistic context in its Latin languages. Spain, and to a lesser extent, Portugal, have reached out to their brothers and sisters of the common language over the past decade in events on both sides of the Atlantic. Florianopolis was probably a pivotal landmark, as the initiative for the Latin American Community Nutrition Group (GLANC) moved by two Spanish colleagues – **Lluis Serra-Majem** and **Javier Aranceta** – convened an organizational social. It had been announced a few months earlier in Barcelona at the I World Congress on Public Health Nutrition (WCPHN). GLANC met again at the SLAN meeting in Santiago, and again with the II WCPHN in Oporto, Portugal in 2010 (associated with the international celebration of the 25th anniversary of CeSSIAM).

Another Spanish current centered around **Ascension Marcos** in the discipline of immunonutrition has forged transatlantic integration, with a series of workshops in Spanish cities, and two in the Americas (Toluca, Mexico and Buenos Aires, Argentina). Prof. Marcos is prominent on the larger European stage, as the Scientific President of the 2011 European Congress on Nutrition, held in Madrid. She is prominent in the planning of the Scientific Program of the XX International Congress on Nutrition to be held in Granada, Spain in 2013, under the overall leadership of **Angel Gil**.

The University of Granada, moreover, is now the alma mater of our CeSSIAM colleague, **María-Jose Soto-Méndez,** who finished her masters degree in nutrition in 2011.

About half of the people mentioned in this editorial and other members of their institutions in Guatemala and Spain will be in Havana in the fall, bringing this integration of "Latin" to the XVI SLAN Congress. I am certain that the transformation will continue to accelerate with all of the opportunities that may present themselves in Cuba.

Noel W. Solomons MD

Non-processed, Processed and Ultraprocessed Foods Offered in the menu of the Community Homes of the Secretariat of Beneficial Works of the First Lady of Guatemala (SOSEP)

Maria Jose Soto-Méndez, Liza Hernández, Noel W. Solomons

The foods and beverages served in the Community Day-care Centers program of the Secretariat *of Beneficial Works of the First Lady* (SOSEP) has been described in terms of its offering of energy and nutrients in an accompanying Abstract in this issue of the BULLETIN (pages 4-5). The dimensions of adequacy and inadequacy of dietary intake need not be the only measure of the suitability of the SOSEP menu. Its influence on healthy eating practices is another level of contribution. SOSEP Centers are generally located in the countryside, such that the traditional foods acquired or prepared locally would be the logical makeup of the menus. It has been alleged that the ingredients added and the treatments undergone in the processing of the foods decreases the healthfulness of the products. For instance, a ripe, raw apple may be healthier than a drink of commercial apple juice, in terms of both the additional fiber from the skin and pulp of the whole fruit and a reduced glycemic index and the lack of additives (including sugar) and preservatives in the beverage form.

Monteiro et al.(1) devised a new classification system for foods in terms of degree of food processing, namely: unprocessed, processed and ultraprocessed as illustrated in the **table**.

For the sake of exploring the degree of processing of the diet of the children attending the SOSEP Centers, we classified all food and drink items consumed into the categories proposed by Monteiro. Given that Guatemala is a country with regulations on nutrient fortification, several foods were classified as ultraprocessed food products (GIII) in our study. These include vitamin A fortified sugar, iodine fortified salt, iron fortified wheat flour, and iron fortified corn flour.

The proportions of items classified into each group were analyzed by mentions, weight, and energy. As illustrated in **figure 1**, approximately two-thirds of items were classified as "unprocessed or minimally processed foods" (GI) when examined by mentions of weight. When examined by energy contribution, only approximate one-fourth were classified as GI. Ultraprocessed foods are more energy-dense than unprocessed and processed foods.

In addition, we quantified the fiber and sodium contribution of all items by processing groups and illustrated in **figures 2 & 3**. Unprocessed or minimally processed foods (GI) provide more fiber to the diet, whereas ultraprocessed food products (GIII) tend to be richer in sodium.

We conclude that SOSEP menus still conserve a predominance of unprocessed items. Association of energy density, and sodium content with ultraprocessing clearly stands out.

In some cases, processing in the form of fortification, is a public health action to reduce the population lack of micronutrients.

References:

1 Monteiro CA, Bertazzi Levy R, Moreira Claro R, Ribeiro de Castro IR. A new classification of foods based on the extent and purpose of their processing. Cad. Saúde Pública. 2010;26:2039–49.

Table: Food classification based on the extent and purpose of industrial processing

Food Group	Extent of Processing
GI: Unprocessed or minimally processed foods	Unprocessed or physically processed, single whole foods.
GII: Processed culinary or food industry ingredients	Extraction and purification of components of single whole foods, resulting in producing ingredients.
GIII: Ultraprocessed food products	Processing of a mix G II ingredients and G II foodstuffs. Any fortified food item.

Figure 1: 40-day menu proportions by mentions, weight, and energy

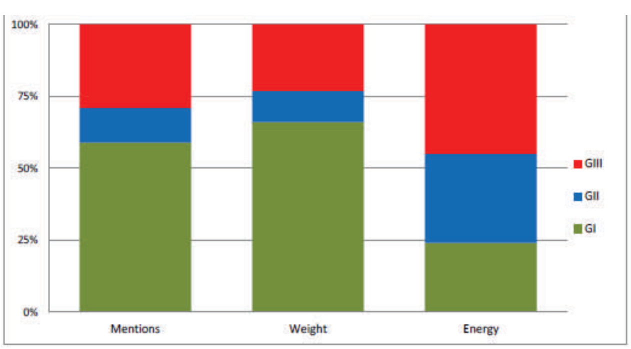


Figure 2: 40-day menu fiber proportions by degree of processing

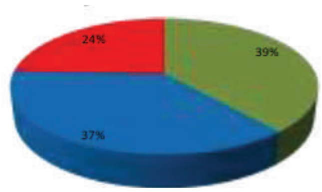
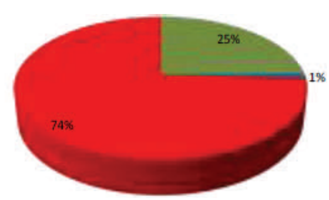


Figure 3: 40-day menu sodium proportions by degree of processing



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Nutrient offering from the menu of the Community Homes of the Secretariat of Beneficial Works of the First Lady of Guatemala (SOSEP)

Liza Hernández, Gabriela Montenegro-Bethancourt, Noel W. Solomons, Odilia Bermúdez

The Guatemalan national program Community Homes is a strategy that contributes to the reduction of poorness, focusing on the use of traditional and affordable resources. The program involves the participation of the community and is run by the *Community Day-care Centers program of the Secretariat of Beneficial Works of the First Lady* (SOSEP is the acronym in Spanish). The objectives of this program are to facilitate healthy growth and development of all children up to six years of age. The emphasis lays on nutrition, school readiness, early stimulation, preventive health, protection, values and habits formation.

The program Community Homes works through the designation of a physical space within a household, where a mother attends ten children from Monday to Friday for twelve hours per day. These mothers work for the community and are supported by young volunteers and a person who orients her. Every child receives two formal meals and two snacks each day. The program is in working in 196 villages of 22 Departments of Guatemala, attending 13,496 boys and girls. The program provides 8,995 beneficiated mothers with an extra income (1).

In order to assess the nutritional quality of the meals offered by the Community Homes, we examined the menu served at SOSEP. A formal menu exists which was designed to feed 10 children over a period of 8 weeks (40 days). Recipes include portion sizes in household measures. We examined all recipes and desegregated them into ingredients and designated weights in grams for each item. Using the Department of Agriculture of the United States Food Composition Table (USDA) version 22.0 we computed estimated daily contributions of energy, macronutrients, 21 micronutrients and 3 fatty acids.

The mean daily contribution of energy and nutrients of the Community Homes menus are presented in **table 1**. The daily energy contribution was almost 1500 kcal, which covers 82% of the age-specific energy recommendation (2). The average protein and carbohydrates contributions of the meals served in the homes were higher than the age-specific requirements, 258% and 174% respectively (2).

The Community Homes menus were adequate in terms of vitamin contributions. The estimated daily contribution of 8 of the 11 vitamins examined exceeded the Daily Reference Intake (DRI) (3). The menus provided almost half (45%) of the daily Recommended Dietary Allowance (RDA) for vitamin D (3). Vitamin A intake was particular high because of the mandatory fortification with vitamin A and high sugar consumption. Vitamin A contribution of the menus was twice the RDA of the Institute of Medicine (4). The Community Homes menus provided 204% of the iron RDA and 102% of the zinc RDA. Half (55%) of the daily calcium DRI was also provided (4).

The Community Homes menus are composed of 85 items served over a period of 40 days. Nevertheless, the sources for each nutrient are limited. Table sugar was the main source of energy, carbohydrates and vitamin A. *Incaparina*® was the main source of niacin, calcium and zinc.

The energy and nutrient contribution of the menus was also analyzed by meal-time (breakfast, morning snack, lunch and afternoon snack). The energy contribution of each meal is presented in **figure 1**. Lunch was the main meal of the day with generous portion sizes, and provided 59% of the daily energy. The typical breakfast included eggs and a variety of gruels and provided one-fourth of the daily energy. Snacks were relatively small, usually just fruit or bread.

When examining the contribution of micronutrients by meal-time, we observed that lunch was generally the most important source. Breakfast, however, was a better source of vitamin D and calcium, because its principal sources were dairy products. The average micronutrients contribution of each meal is presented in **figure 2**

We can conclude that if the Community Homes menus if prepared and served exactly as intended, the daily contribution of energy and nutrients would be adequate for energy and most nutrients for pre-school children. The daily adequacy of vitamin D intake would depend on the complementary foods served in the homes, however these are unlikely to be important sources. On a precautionary note, the contribution of vitamin A and iron are well above the upper tolerable limit 900 µg, 12 mg/d respectively and this should be considered.

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Table 1. Average daily contribution of energy, macronutrients and 10 selected micronutrients

Nutrient	Average ± SD	Range	DRI-RDA	Percentage of DRI-RDA (%)
Energy (kcal)	1470 ± 100	1343-1640	1800	82
Protein (g)	61.6 ± 7.8	51.4-73.6	24-30	258-207
Carbohydrates (g)	226 ± 25	193-267	130	174
Fat (g)	36.8 ± 6.0	30.5-48.1	25-35	147-105
Vitamin A (EAR)	1440 ± 617	1124-2947	500	288
Vitamin D (mg)	4.3 ± 0.4	3.6-4.7	10	43
Vitamin B12 (μg)	4.3 ± 4.7	2.0-15.9	1.4-2.0	307-215
Thiamine (mg)	1.6 ± 0.2	1.4-1.9	0.9	178
Riboflavine (mg)	1.5 ± 0.1	1.3-1.8	1.1	136
Niacin (mg)	21.4 ± 2.6	18.3-27.0	12.0	178
Folates (μg)	491 ± 77	364-578	200	245
Iron (mg)	20.4 ± 1.2	18.4-22.1	10.0	204
Zinc (mg)	10.2 ± 1.5	8.1-13.3	10.0	102
Calcium (mg)	553 ± 48	484-635	1000	55

Figure 1 The energy contribution of the **Community Homes** menus by meal-time

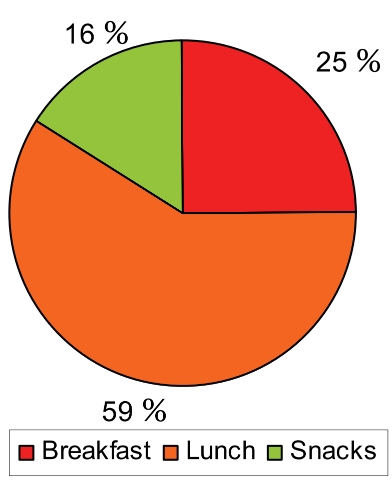
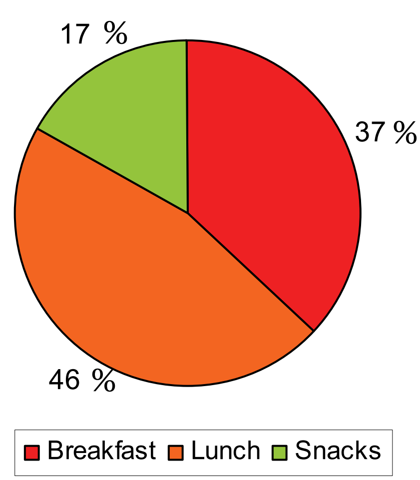


Figure 2 The average micro contribution of the **Community Homes** menus by meal-time



Validation of a pictorial method for registering one-day food consumption in preschoolers

Cinthya Pinetta, Marieke Vossenaar, Noel W. Solomons

The assessment of dietary intake of individuals is challenges by a series of technical factors. With immediate recall methods, such as the standard 24-hour recall, valid memory for exactly the foods eaten over the past day is often poor. Some items are forgotten, whereas others are invented. With long-term intake approaches, such as the food-frequency questionnaire (FFQ), imprecision in the true periodicity of ingestion of foods is common and subjects tend to over-report participation in consumption. Moreover, with both methods, the accurate estimation of the portion sizes consumed is a recognized problem.

When it comes to assessment of children's diets, these problems take on larger dimension. If one relies on the parents, foods consumed away from home often escape reporting. If one interviews the child, the memory distortions may be magnified. As such, CeSSIAM pioneered some 9 years ago, a pictorial method, in which school children to crayons and a workbook home from school and depicted in drawings the food and beverages consumed in the following 24-hour eating cycle. In the first use at CeSSIAM, in 2003, children were not consulted about the amounts consumed. To calculate intakes, standard portions were established and assigned for all items. Some 7 years ago, in 2005, a more refined approach was developed in Quetzaltenango, in which a trained nutritionist interviewed the child subjects at the time the workbook was handed in about the sizes and amounts of the depicted items consumed. This study, called "Xela Children," has led to an array of publications, but the accuracy of the children for reporting the current items or allowing for a valid estimation of energy and nutrient intake had never been assessed.

As part of a masters thesis for the *Maestría en Alimentación y Nutrición* program at the University of San Carlos in Guatemala, the first author conducted a validation study. She chose the clandestine-observation approach, and had pictorial registries made in schoolchildren boarding schools in which all meals were prepared in a common kitchen and served in the dining halls.

A total 75 children, 38 boys and 37 girls, aged 7 to 11 yrs old participated in the study. All drinks and foods consumed within a 24-h frame were directly recorded by a trained, independent observer. Recipes and portion sizes were previously determined in the kitchen. The same day, children were asked to complete a pictorial registry. The booklet was given to the children before breakfast with clear instructions. All registries were checked by a nutritionist for completeness and portion sizes the following morning.

Observed (direct observation) and reported (pictorial registry) intakes were compared by mentions as illustrated in **table 1. *Omissions*** (forgotten items), defined as foods observed but not reported and **intrusions** (invented items), defined as foods reported but not observed were calculated separately. The number of omissions was greater than the number of intrusions, thus more items were observed than reported. Drinks were omitted more commonly (28%) than foods (18%) when examined proportionally. When comparing observed and reported energy intakes (**table 2**), the observed intake was greater by 226 kcal for all items, 2 kcal for drinks and 313 for foods only. This represents 13%, 1% and 22% of the observed intakes for all items, drinks and foods, respectively.

Furthermore, the reported, omitted and intruded intakes of energy and nutrients were computed as the proportion of observed intake as reported in **table 3**. Reported intake, as a proportion of observed intake, varied between 77% for iron and 94% for vitamin C. Omissions varied between 16% for iron and 35% for fat. Intrusions varied between 31% for vitamin B6 and 42% for fat.

Pearson correlations were used to compare observed and reported intakes. As shown in **table 4**, correlations ranged between 0.441 for vitamin C and 0.895 for riboflavin. All were statistically significant ($p<0.001$).

Finally, children were classified as having adequate or inadequate nutrient intakes based on the observed and the reported estimated intakes. The degree of concordance and discordance in this classification between dietary assessment methods was computed. If a child was classified as inadequate or adequate with <u>both</u> methods, the methods were considered "concordant". Concordance between methods presented in **table 5** varied between 70.7% for zinc and 85.4% for calcium, whereas discordance varied between 14.6% for calcium and 29.3% for zinc.

The pictorial registry seems to be a valid dietary assessment tool amongst 7-11 year old Guatemalan children at the group level.

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Table 1. Numbers of drink and food items **observed**, **reported**, **omitted** and **intruded** in all children (n=75)

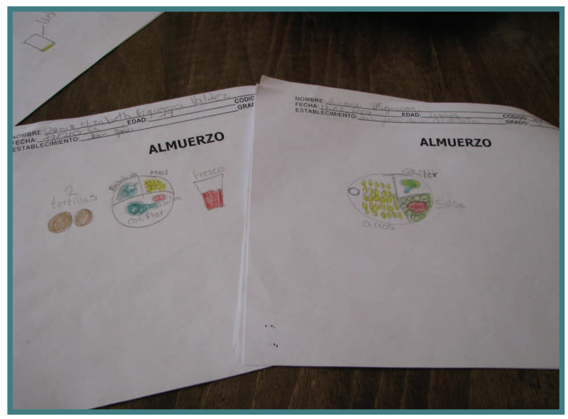
	Number of mentions			
	Observed	Reported	Omissions	Intrusions
All items	1081	1008	224	151
Drinks only	274	246	77	49
Foods only	807	762	147	102

Table 2. Energy contribution from drink and food items **observed**, **reported**, **omitted** and **intruded** in all children (n=75)

	Median energy (kcal)			
	Observed	Reported	Omissions	Intrusions
All items	1779	1553	677	391
Drinks only	382	380	91	81
Foods only	1416	1103	512	252

Table 3. Reported, **omitted** and **intruded** intake of energy and nutrients as a proportion of **observed** intake in all children (n=75)

	Proportion of observed intake (%)		
	Reported	Omissions	Intrusions
Energy (kcal)	85	23	38
Protein (g)	82	23	41
Carbohydrates (g)	83	20	36
Fat (g)	93	**35**	**42**
Vitamin A (EAR)	80	17	37
Thiamin (mg)	80	17	37
Riboflavin (mg)	86	21	35
Vitamin B6 (mg)	93	24	**31**
Vitamin C (mg)	**94**	32	38
Calcium (mg)	84	23	39
Iron (mg)	**77**	**16**	39
Zinc (mg)	82	24	41



Example of pictorial registry

Table 4. Pearson correlation between **observed** (direct observation) and **reported** (pictorial registry) energy and nutrient intakes in all children (n=75)

	Pearson Correlation
	r
Energy (kcal)	0.802
Protein (g)	0.627
Carbohydrates (g)	0.814
Fat (g)	0.725
Vitamin A (EAR)	0.832
Thiamin (mg)	0.829
Riboflavin (mg)	**0.895**
Vitamin B6 (mg)	0.856
Vitamin C (mg)	**0.441**
Calcium (mg)	0.665
Iron (mg)	0.876
Zinc (mg)	0.677

* All correlations were statistically significant ($p>0.001$)

Table 5. Degree of concordance **and discordance between observed (direct observation) and reported (pictorial registry) in all children (n=75)**

	Concordance	Discordance
	%	
Vitamin A	82.7	17.3
Thiamin	82.7	17.3
Riboflavin	85.3	14.7
Vitamin B6	78.6	21.4
Vitamin C	78.7	21.3
Calcium	85.4	**14.6**
Iron	72.0	28.0
Zinc	**70.7**	29.3

Hemoglobin concentration and anemia in urban and rural preschool children

María-Eugenia Romero-Abal, Liza Hernández, Richard Herreid, Melissa JL Bonorden, Noel W. Solomons

Anemia is the condition in which the volume of circulating red cells is insufficient to transport the optimal amount of oxygen to the tissues. It is most common in young children, pregnant women, and women of reproductive age. The estimated global anemia rate, worldwide is 24.8% [1]. It is estimated that 47.4% of under-five children in developing countries have anemia [1]. It is estimated that the rate of anemia among under-five children in Guatemala is 38.7% [2]. The WHO considers an anemia prevalence of >40% in a population segment as a public health problem requiring intervention [3]. The intervention suggestion is the universal provision of iron and folic acid to all members of the population in the specific [3].

Anemia is defined, for practical purposes, by a series of cut-off criteria for populations living at sea-level. For children from 6 to 59 months, anemia is diagnosed by a hemoglobin concentration of <11.0 g/dL; for children from 60 to 144 months, the criterion moves up to <11.5 g/dL [1]. As populations inhabit higher altitude above sea-level and the ambient oxygen tension declines, the criterion for anemia must be adjusted progressively to higher Hb concentration [4]. The important assumption with regard to anemia in developing countries has been that a majority of the anemia will be iron deficiency anemia, due to a lack of iron, and would respond to the administration of oral iron. That is the justification for the WHO recommendation [3].

The measurement of biomarkers, such as serum ferritin, soluble transferring receptor or even saturation of transferring, can provide a diagnosis of iron status. In this context, a careful review of the recent literature has shown for some time now that not all the anemia, even in young children, is caused by the deficiency of iron. A recent study from Egypt among infants in the second semester of life showed that only 50% of the anemia was attributable to iron deficiency [5]. Another common cause of anemia in populations of developing countries is believed to be inflammatory anemia or anemia of chronic disease [6]. It is characterized by the presence of normal values in iron status biomarkers and elevation of inflammatory biomarkers [6].

CeSSIAM has recently had the opportunity to assess the hematological status of children attending three feeding centers within the network of the Archdiocese CARITAS of Guatemala City. The survey included the measurement of a complete hematogram (including Hb), ferritin and a marker of inflammation. As can be seen in **Table 1**, the hematological indices were, in first instance, generally normal for the population of children studied. The average values were within the normal limits suggesting that red cell deficit, hypochromia, and neither microcytosis nor macrocytosis predominated in the population. Of the 100 subjects enrolled, 18 had evidence of active inflammation in terms of an elevated C-reactive protein, such that the ferritin value could be interpreted in terms of individual iron status in only 72%. As illustrated by the comparison of iron sufficient and iron deficient subjects, the red cell indices were comparable as divided by iron status (**Table 1**). Another overall perspective on the hematological status of the population is shown in **Table 2**, in which the rates of anemia and non anemia are disaggregated in relation to the iron status diagnosis in this 72% without inflammation.

The pie-graphs in **Figure 1** classify the hematological status into the percentage of the sample and subsample populations that were not anemic and the percentages anemic, with the three different categories for anemia: iron deficiency anemia; presumptive inflammatory anemia; and idiopathic anemia (anemia with neither iron deficiency nor inflammation by biomarkers). The idiopathic anemia represented 8% of all subjects in both geographic areas. The rural population, however, had twice the representation of idiopathic anemia and four times the representation of continuing with the geographic perspective, **Figure 2** illustrates pie-graphs for iron deficiency (low ferritin) and non iron deficiency (adequate ferritin) in the individuals without endogenous inflammatory stimulation. A slight majority of rural population were actually iron deficient, whereas only one in six urban subjects was deficient in this nutrient.

In conclusion, ambient rates of inflammation were found to be very high, specifically in the rural area. However, the rate of iron deficiency in children without inflammation was also much higher in the rural area. The overall rate of anemia in this population of children between 36 and 72 mo was 19%, which is one-half that of the corresponding rate for the standard under-five age range in the most recent national survey. Consistent with a modern tendency in developing countries, only a minority of the anemia could be attributed to iron deficiency. Only a small additional fraction can be attributed to active inflammation. The red blood indices do not suggest any macrocytic factors suggestive of folic acid or vitamin B12 deficiency, although there was widespread deficiency of this vitamin as indicated in the Abstract on pp 10 – 11.

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Table 1. Distribution of the values of hematological indices of the whole group of subjects, disaggregated by normal (CRP <5 mg/L) o elevated (CRP $\geq$5 mg/L)

CRP	RBC (x 10^{E}6/µL)	MCV (fl)	MCH (pg)	MCHC (g/dL)	RDW%
Elevated	46±0.3	82.7±3.1	27.1±1.2	32.9±0.6	11.7±0.8
Normal	4.6±0.3	82.0±2.6	26.6±3.1	32.8±0.7	11.8±0.9

CRP=C-reactive protein; RBC=red blood cell count; MCV=mean corpuscular volume; MCH=mean corpuscular volume; MCHC=mean corpuscular hemoglobin concentration; RDW%=percent red blood cell distribution width.

Table 2. Classification as non-anemic or anemic among subjects with normal CPR values, using the WHO cutoff criteria, adjusted for altitude, and separated for iron status, as assessed by ferritin.

	Anemia status	Ferritin <20 ng/ml	Ferritin $\geq$20 ng/ml	Total
Total	Non-Anemic	21	38	59
	Anemic	5	8	13
	Total	26	46	72
Urban area	Non-Anemic	5	26	31
	Anemic	1	4	5
	Total	6	30	36
Rural area	Non-Anemic	16	12	28
	Anemic	4	4	8
	Total	20	16	36

Figure 1. Pie-graphs of the percentage distribution of anemia status of the whole sample and geographic subsamples as disaggregated by non-anemics and various classifications of putative anemia origin

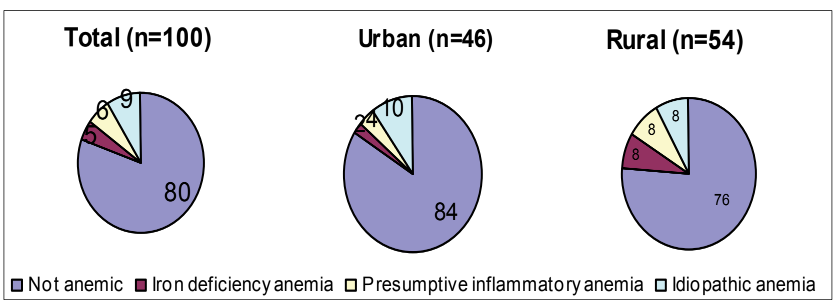
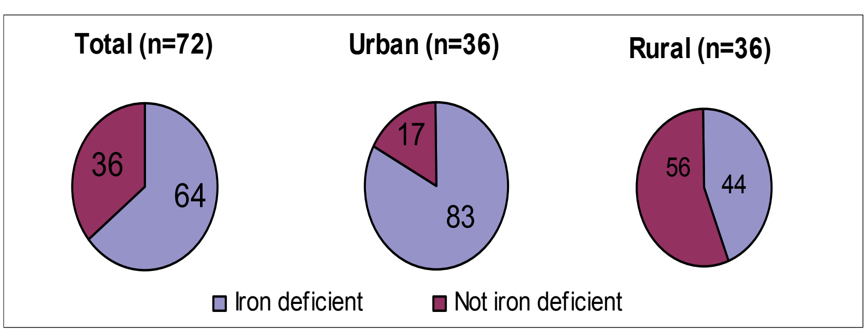


Figure 2. Pie-graphs of the percentage distribution of iron status among subjects without evidence of inflammation as disaggregated by geographic areas



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Status of two "orphaned" vitamins – vitamin B12 and vitamin D – in urban and rural preschool children

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Vitamin D is often called the "sunshine" vitamin because it can be synthesized in the skin by exposure to ultraviolet energy from the sun. As such, for the tropical areas of the world, with direct and intense sunlight, little concern had been expressed for the nutritional status for this vitamin in the tropics. It had become an orphaned vitamin in this region. What was being ignored, however, is that cloud cover prevails during the rainy seasons, that residents often cover much of their bodies in traditional garments, and that the foods rich in vitamin D, such as dairy products and marine fish, are sparely consumed.

Once the topic of vitamin D began to be addressed in the tropical latitudes, the lid sprang off of Pandora's Box. A CeSSIAM study among older Mayan residents of the Western Highlands of Guatemala in the Quetzaltenango Province demonstrated a high prevalence of low and marginal values of 25(OH) vitamin D and only rare instances of optimal levels of this biomarker were seen [1]. Aging of the human skin is accompanied by a reduced efficiency of bioconversion of the cholesterol precursors of vitamin D to the active vitamin. Young skin is an efficient converter. Moreover, the lifestyle of preschool children should see them having many hour of outdoor activity during the sunny times of the day.

Vitamin B_{12} is essential for the nutritional health of the hematological and nervous systems. It has a complex mechanism for its absorption, involving various gastric secretions and an elaborate small intestinal receptor. Populations of Mesoamerica seem to be prone to deficiency of the vitamin for putative ecological reasons, as deficient vitamin B_{12} status has been found in Mexico, Guatemala and Panama [2-4].

Given the emergence of indications of a problem and the lack of widespread investigation of the topic, we must consider vitamin B_{12} to be an "orphan" among micronutrients in public health circles. In the context of studies with multiple micronutrient fortification interventions, CeSSIAM has renewed the interest in vitamin B_{12}.

We present here the results for circulating 25(OH) vitamins D and vitamin B_{12} concentrations in rural and urban preschool children participating in a survey supported by the *Hormel Food Corporation*. A total of 112 children, aged 3 to 6 years, from Antigua Guatemala (urban), Zone 1 in Guatemala City (urban), and the hamlet of San Jeronimo Chuaxan, San Juan Sacatepéquez (rural). A total of 104 samples of serum – 47 urban and 57 rural – were successfully obtained for analysis. The analytical collaboration for the assays of vitamin D was the *Osteoporosis Research Center* of the *Endocrine Division of Creighton University* in Omaha, Nebraska, USA and for vitamin B_{12}, the *Vitamins and Aging Laboratory of the Human Nutrition Research Center on Aging* in Boston, Massachusetts, USA.

The mean vitamin D levels observed in the urban and rural areas were similar (**Table1**). When categorized into deficient (<20 ng/ml), insufficient (20-30 ng/ml) and normal (>30 ng/ml) levels, differences between children from rural and urban areas were observed (**Figures 1** and **2**). In both areas, about half the children had insufficient levels of vitamin D (59% urban and 54% rural). One-quarter (26%) of children living in the rural areas had deficient levels of vitamin D versus 13% in the urban area.

For vitamin B_{12} a different scenario was observed. Significant difference in mean values were observed between the sites ($p<0.001$), with higher levels in the urban sample (**Table1**). When classified into deficient (<200 pg/ml), marginal (200-300 pg/ml) and normal (>300 pg/ml) categories difference were seen (**Figure 3** and **4**).

In the urban population no deficient values for vitamin B_{12} were seen and only a small proportion had marginal levels (10%). In the rural areas, 18% of children had deficient values, 39% marginal and 43% normal values.

The difference in levels of circulating 25 (OH) vitamins D and vitamin B_{12} concentrations in rural and urban preschool children are likely to be a consequence, at least in part, of differences in dietary sources of these nutrients. In rural areas the availability of dairy products and animal products in general, are limited..

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Table 1. Vitamin D and Vitamin B_{12} average distribution by area

	Vitamin D (ng/ml)			Vitamin B_{12} (pg/ml)		
Setting	Mean ± SD	Median	Range	Mean ± SD	Median	Range
Urban (n=47)	27 ± 5	27	17-43	583 ± 294*	527	243-1430
Rural (n=57)	24 ± 6	25	7-41	339 ± 181*	289	161-1024

* $p<0.001$

Figure 1. Vitamin D status in the urban area

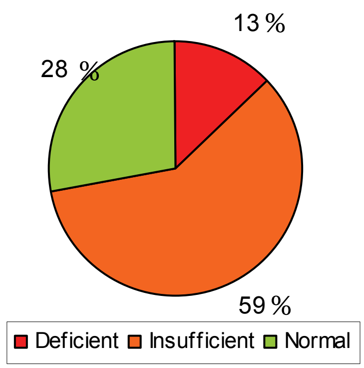


Figure 2. Vitamin D status in the rural area

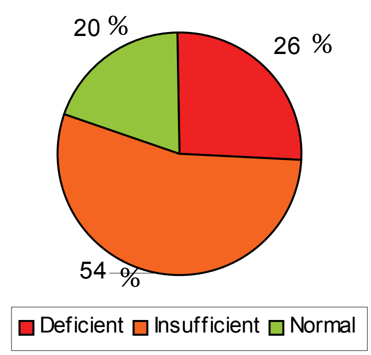


Figure 3. Vitamin B_{12} status in the urban area

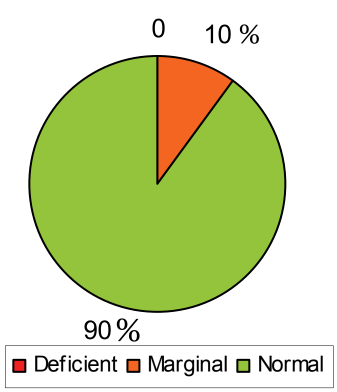
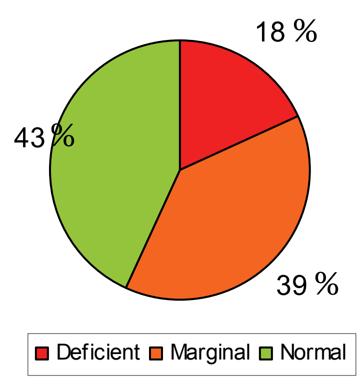


Figure 4. Vitamin B_{12} status in the rural area



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