THE MEASUREMENT OF INDIVIDUALS' FOOD INTAKE IN LONGITUDINAL NUTRITIONAL STUDIES IN POOR RURAL COMMUNITIES IN GUATEMALA*

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CONTENTS

I BACKGROUND

A) Introduction

The present report on dietary methodology has been prepared at the request of the Agency for International Development (AID).

For the past 4 years, AID has supported field research activities including the development of a valid and reliable method for measuring the food intake of mothers and children.

For reasons that will become clear, the INCAP group selected the traditional 24 hours recall method and introduced a series of modifications that substantially improved the method.

Readers interested in other dietary techniques are referred to the excellent reviews by Marr(1) and more recently by Burk and Pao (2) for developed countries, and by Flores et. al (3) and Lechtig et. al (4) for developing countries.

The report begins with a brief history of food consumption studies in Central America (I.B.). A subsequent section (II) reviews the specific modifications introduced to improve the accuracy and validity of the traditional 24 hours recall method. A latter section (III) discusses the significance of the methodological achievements.

Finally, three Appendices are attached :

- The design and objectives of the longitudinal study for which the method was developed.
- The detailed results of three studies designed to improve the accuracy of corn consumption estimations and
- The detailed description of the final 24 hours recall method.

B) Food consumption studies in the Central American isthmus

While studies of family and individual food consumption were being carried out prior to the 1930's in developed countries, it was not until the 1950's that similar work began in Central America, with the founding of INCAP.

INCAP's task was to select and modify the methods used in developed countries to the Central American situation. For example, recall dietary surveys in developed countries were generally collected in clinics or special locals, the interviewers were frequently trained nutritionists and the informants were likely to be well-educated (2).

By the 1950's, the Central American situation was very different. First, the interviews took place at the informants' home because of the lack of clinics in most villages.

Furthermore, most populations were illiterate, a problem which created a barrier in terms of the understanding of the nature of the study and the possibility of obtaining cooperation in the recording of specific food quantities. Other behavioral aspects, such as a wide variation in the type and quantities of ingredients used in common dishes, precluded the use of standard recipes and required recipes for each family. Diets also needed to be collected using various methods at the same time. To avoid altering the family's eating behaviour, cooked foods were weighed before the meal, and information about left overs was collected on a later visit after the meal. It was soon realized that children and a adults were likely to feed animals during meal times; these quantities had to be estimated by recall.

There were some advantages to interviewing at home. Firstly, the informantwas surrounded by her family environment and the interview was conducted in more a familiar atmosphere. Secondly, most houses in rural areas are composed of a single room where food preparation and other household activities are conducted. Thus the interviewers were able to verify the consumption of the reported food items, to elucidate doubts arising from identification of specific foods which may be given different names within the same region, and to collect weights and measures of foods and kitchen utensils for each family.

To Emma Reh and the local nutritionists whom she trained in the 1950's we owe large amounts of valuable information detailing family consumption behaviour of various countries in the isthmus. Those initial efforts were aimed not necessarily at the estimation of energy and nutrient intakes, but at the description of food consumption patterns, at household food economics and at the determinants of consumption patterns.

The method used in Central America throughout the 1950's was the recording of each meal for a period of seven days. The studies were focused on food consumption of families, and no specific data were collected for individuals.

At the end of the 50's, and the beginning of the 1960's INCAP carried out a number of classic field studies on health and nutrition interventions (5-7). A new method replaced the 7 day recording of family consumption. The new method was a combination of recording and recall methods; a 3 day determination of family as well as individual food intake.

In 1965-1967 INCAP conducted national nutrition surveys for its six member countries. The food consumption component was ascertained in a subsample of families and children under 5 years of age for a period of 3 days by a combination of recording and recall methods (8). However, more simplified methods such as the 24-hour recall in a clinic and the 24 hour recall at home

were studied in some families (3). The reports of these studies concluded that the 24-hour recall at home was a reliable estimate of the mean energy and nutrient intake of the population (3). Furthermore, in order to ascertain the accuracy of dietary energy and nutrient estimates made using the Food Composition Tables (9); a comparison was made with chemical evaluations from mixed food samples. The conclusion was that results of dietary surveys in this region whose energy and nutrient intake were determined by the application of food composition tables, gave accurate estimations of real energy and nutrient consumption (10). These findings were subsequently corroborated in another study conducted in Eastern Guatemala (11).

The applied focus of INCAP's activities in the late 60's and early 70's demanded the organization of large scale longitudinal field studies where the food consumption component needed to be measured (12-15). While the objectives of each of the research projects and the role of the dietary component within each were different it was agreed at INCAP that the method selected, while providing accurate consumption estimates, should not occupy much of the informant's time, nor modify the families and individual's usual patterns of food consumption. Furthermore, data should be collected frequently for the same families and individuals. Thus most of these longitudinal studies have utilized the recall method at home with variations in the period to be recalled, 24 or 72 hours, depending on the specific project.

The results of the validation studies in these projects pointed out that the 24-hour recall method yielded accurate mean energy and protein estimates for groups (4, 12), but as demonstrated by correlation coefficients, when compared with more precise methods, the 24-hour recall method provided poor estimates of individual intakes on a given day.

Reliability is another facet which is of paramount importance in dietary studies. The component related to bias introduced by low coverage of surveys as a result of negative families or unreliable records is very different in our studies in the Central American isthmus from that reported from investigators of developed nations. INCAP's experience is cross-sectional and longitudinal studies, where a dietary component has been measured, can be summarized as follows : In the national nutrition assessment of 1965-1967 it is estimated that losess of data, as resulting from negative families, was around 1% contributed mostly by Indian communities in Guatemala. In other countries such as Costa Rica and Panamá, no families were reported as "negative", that is unwilling to provide information. More re-

cent studies in Costa Rica (16) have corroborated the 1966 findings in terms of cooperation of families.

Our experience in rural Indian communities in Guatemala is that less than 5% of families may be reluctant to cooperate in providing dietary information. However, once contacts in these families are made with the head of the household, and more details are given to him with respect to the objectives of the study, the percentage of negative families can be reduced dramatically.

Data rejection due to problems of accuracy is minimal. Through a weekly data editing procedure in the longitudinal study described in Appendix A, we detect about 2% of all reports with consumption values which are out of acceptable energy and protein ranges. When those cases are analyzed in more detail in the original forms, they are likely to be reports with low intakes as a result of the presence of morbidity episodes or other similar factors which influence food consumption or/of coding or punching errors. We can confidently assure that less than 1% of the reports were discarded due to unreliable information. Thus, negativism and unreliable reports are of much less significance for dietary surveys in developing countries than is the case in U.S.A. and Europe (1,2).

Taking advantage of experience gained over more than 20 years of dietary surveys in the area, INCAP embarked in a field project in 1976 (see Appendix A) in which the accurate estimate of energy and protein intake for groups, and individual was a very relevant component.

This report summarize the strategy used to obtain more accurate food consumption data in a large scale longitudinal studies.

II THE MEASUREMENT OF TOTAL NUTRIENT INTAKE OF INDIVIDUALS

A) Characteristics of the required energy and protein intake data

The research objectives and main hypotheses of the Patulul Project (see Appendix A) called for basic analyses to be conducted at the community and not at the individual level. In spite of this, the research team was requested to measure treatment effects, primarily at the individual level and secondarily, at the group level.

The Patulul Project undertook the task of devising a food consumption survey method which would yield the best possible measurement of usual total protein and energy intake of individuals and thus, of classes of individuals in a certain time

period, as these measurements were related to weight and height changes occurring during the same period.

An acceptable measurement was defined as that which would provide reliable and unbiased estimates during the project baseline and intervention phases (see Appendix A). The magnitude of the differences in total nutrient intake between baseline and intervention phases was 7.6 g of ideal protein and 250 kcals., as the mean for all age groups studied. Thus, the dietary information needed to be valid and should not contained large, systematic errors attributable to individuals.

The data also needed to be reliable; that is, random error variance should not explain a significant portion of the total variance.

The selected method was to be feasible for epidemiological studies and it should not only yield valid estimates for individuals, but in order to tap variations within individuals in their usual intake pattern over a period of time, several measurement in the same individual were also necessary. From information available in the literature, it was considered that higher precision on the individual's intake was likely to be obtained with more frequent observations in the same individual rather than with fewer measurements covering longer time periods.

B) Review of existing methods

Three alternative methods were reviewed in order to determine the one most likely to fullfill the above requirements : direct weighing, recording and the 24-hour recall method.

The direct weighing and the food recording method were discarded on 3 grounds. First, only a few evaluations per individual were possible without using a prohibitively large number of trained diet survey personnel. A second concern was the cooperation of families and the likely bias to be introduced by lack of response from non-cooperative families. Thirdly, in most studies where those methods have been used, the investigators have reported important modifications in the usual patterns of food consumption, as a result of the presence of outsiders, in the household and/or the weighing of food items (2).

Before 1976, several members of the Patulul Research team had been engaged in a longitudinal study conducted in Eastern Guatemala (14, 17) where food intake data and children's growth information was collected for several years. From that experience, as well as other available evidence in the literature (3, 4, 12) it was concluded that the one day recall survey was sufficiently valid and reliable to estimate mean dietary calorie

and protein intakes for population groups. Although the reliability on one 24-hour recall measurement for estimating individual intake was low, frequent surveys per person were likely to provide a reliable estimate of an individual's usual intake.

Thus, the dietary recall survey was left as the most practical technique available for repeatedly estimating intakes for large numbers of individuals in long-term nutrition field studies where estimates of usual intake for individuals and population groups are frequently required.

The 24-hour method was chosen over longer-term recall surveys, to reduce memory errors by shortening the length of the interview.

However, the very simplicity of the 24-hour recall dietary surven introduces many sources of error and many investigators are reluctant to utilize the method or to accept conclusions derived from such data for estimates of dietary intake at the individual level (18).

C) <u>The selection of the method</u>

The Patulul research team's strategy consisted of improving a simple and rapid technique for dietary intake evaluation based on an existing 24-hour recall methodology. We analyzed the method for those errors which would lead to biased and imprecise measurements. Modifications were introduced which were expected substantially to reduce these problems.
Validation exercises confirmed these expectations.

The most critical errors identified in the previous method were :

1) Memory of the informant
2) Precise weight and measurement for estimation of quantities of foods
3) Precise estimates of "<u>tortilla weights</u>" *
4) The inclusion of secondary food items contained in prepared foods for total food consumption estimates.

The structure of the interview utilized in the previous longitudinal study has been substantially modified in order to tackle <u>the first problem</u>. Data on family intake are collected before information on individuals. The informant, once having given information for the whole family, is then able to recall more precisely, the types of foods eaten by individuals.

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* A flat cake which is prepared by boiling the corn in lime water grinding it into a dough, and cooking it on a metal or clay plate.

Furthermore, information gather on portions and recipies, and included as the fourth type of error listed above, improves the estimates of food "quantities".

Interviewers are also trained to ask specifically about consumption of those "foods" frequently overlooked by informants ie., fruits, coffee, sweets, alcoholic and soft beverages. They also ask about any food reported for the family but not for the individual. Finally, a strong emphasis is placed on obtaining data for foods eaten between meals.

The second type of error deals with the application of mean community measurement values to individuals, ie., spoons, cups, dishes, glasses, etc. The investigator must estimate the weight of the various foods eaten the previous day so as to convert such information into energy and nutrient intake data using food composition tables. The importance of obtaining accurate weight estimates, particularly for frequently consumed foods, is therefore obvious.

With the new method, interviewers gather data every three months on weights and volume of cups, glasses, plates and spoons used in each household by different members of the family. Individual family measures, and not mean community values, are utilized when data are tabulated for individuals.

Field workers have been provided with sets of spoons, cups, glasses, and dishes in order to determine, with more precision and less bias, the real volumes or weights reported for individuals by each informant. A book is kept in each community on weights and volumes used in every household and is updated every three months. Field workers make use of the book when they cannot determine, with their set of utensils, the ones used by individuals the previous day. While the task of obtaining data on weights and capacity of individual specific utensils may be time consuming in developed nations or in the higher socioeconomic classes of developing countries, the variety of large and small spoons, dishes, cups and glasses within families such as those in coffee plantations is very small.

The third type of error is related to the estimation of corn consumption. No other food item accounts for more of the protein and calorie intake than corn in the study area. It represents from 50% to 60% of the total calories consumed by adults and older children. This staple is most often consumed as "tortilla". Thus, the number and weight of the tortillas consumed had to be determined accurately in the 24-hour recall dietary surveys.

Two options have generally been utilized in obtaining tortilla weight estimates for 24-hour recall surveys.

One option is to weigh tortillas at the time of the interview or on selected occasions and to use these values as proxies for those consumed the previous day.
The second option is to use a community mean weight which can be obtained from one or more cross-sectional surveys on some or all individuals in the study populations.

Both options are fraught with problems. Family-specific weights, if required at each interview, are clearly impractical for long-term studies on large numbers of people. The use of previously determined weights for each specific family, particularly if the number of occasions on which these were obtained is small, would not be acceptable if the within-family variation is large. In rural Guatemala, several factors may account for this source of variability. In some families, tortillas are sometimes made by more than one individual. When there is not much wood available for cooking or when the tortilla maker is pressed for time, larger than usual tortillas are made.

In a similar fashion utilizing the village mean as an estimate for the weight of tortillas of all families, clearly leads to serious sources of error because the between-family variance in tortilla weight may be large.

As the usual methodological approaches for estimating tortilla weights were not entirely adequate, efforts were made to provide better estimates of consumption of this food by individuals.

Appendix B describes in détail, the results of 3 studies aimed at improving the quality of corn consumption estimates. A summary of these studies is presented below.

Tortilla weights ranged from 19.6 to 94.4 g. The between family variance in weights was so large as to preclude the use of village means, while the also large within family variance suggested that direct weighing of the prior day's tortillas was necessary.

Variability within the same lot of tortillas, (i.e., within morning tortillas), was low, accounting for only 13.8% of the between family variance.

Three alternatives were available :

1) To weigh morning and afternoon tortillas the day previous to each recall.
2) To use specific mean family weights based on 10 measurements of morning and afternoon tortillas every six months.
3) To use models of distinct tortilla sizes that informants could identify during each household diet survey.

The third alternative was selected for the new method. More details about the 3 studies and the use of these models is provided in Appendix B.

The most important improvements in the previous method are displayed in Table 1. These are designed to reduce systematic and random errors in memory as well as in household weights and measures. As presented in the next sections these improvements have led to a method significantly superior to that utilized by our groups in prior studies.

The present method is described in detail in Appendix C. The information provided to interviewers during the training and standarization periods, and the supervision and quality control systems are described in the same section.

D) RESULTS OF STUDIES FOR DETERMINING VALIDITY AND RELIABILITY

This section contains information related to :

1) The number of surveys necessary to obtain reasonable estimates of the usual intake of individuals.
2) The accuracy of the method (validity) for ascertaining dietary intake, and
3) The performance of repeated measurements of energy and nutrient intake using the 24-hour recall method in order to predict nutritional status of mothers and children as evaluated through commonly used anthropometric measurements.

1.- Number of surveys and size of variance

The first step in ascertaining bias introduced into the intake variance observed in groups of individuals, is to have a clear idea of the expected variance of energy or protein intakes of healthy groups of individuals in a series of standardized conditions.

Energy expenditure and nitrogen excretion studies have demonstrated that, along with a day to day variance within the same individual, one is likely to find true variability in individuals of similar sex and age. For example, the coefficient of variation for energy expenditure in healthy individuals included in metabolic studies is around 10% (19); that is a standard deviation of around 200 calories for a mean energy expenditure of 2,000 calories.

The variance in intake found in field studies is generally

Table 1: IMPROVEMENTS IN THE HOME DIETARY RECALL SURVEY

PROBLEM	USUAL APPROACH	NEW APPROACH	THE EXPECTED BENEFIT
Memory of the informant	Ask only open-ended questions such as: What did you eat for breakfast, lunch, dinner and between meals? Avoid direct questioning.	A) Ask first about all food prepared for the family. B) Question directly about foods not traditionally thought of as foods (fruits, sweets, soft drinks, etc.) or likely to be forgotten (tortillas). C) Ask specifically for more information whenever the homemaker neglects to report consumption of any food prepared for the whole family. D). Question about between meal snacks.	A) Aids the informant later on in remembering foods consumed by individuals. B) Reduction of underreporting. C) Reduction of underreporting. D) Reduction of underreporting.
Household weight and measures	Utilize mean community values	Utilize family specific units of weight and measures. Use the actual family-specific weight of the tortillas prepared on the day asked.	Reduction of systematic (at the individual) and random (at the group level) error.

larger than that observed under metabolic ward conditions because of factors such as morbidity, varying patterns of physical activity and difference economic conditions determining purchasing power and food acquisition. These factors increase variance significantly, especially if only one measurement of dietary consumption is made in the study population.

Dietary information collected in one evaluation of children below five years of age in rural Guatemala, where a combination of the daily recording and recall methods for 3 consecutive days was used, gave a coefficient of variation of 35% for calories and protein (20). The children studied were from distinct rural regions of Guatemala and the different socioeconomic level, dietary and morbidity patterns across the country contributed to the observed level of variability.

During the first months of 1977, a pilot study was carried out in which six dietary surveys were obtained from each individual at 2 week intervals (21).

It was found that the interindividual variance dropped initially as the number of surveys used to estimate the intake of individuals reached four, after which a stable variance was obtained.

Table 2 shows the mean and standard deviations for calories and proteins obtained in adults and children of various age groups when means of repeated measurements of individuals are utilized.

Comparing data when single surveys are used to those when four surveys are used per individual, we note for mothers a reduction of 50% in the standard deviation and a drop in the coefficient of variation from 34 to 17.5% for calories and from 42.5% to 22.5% for protein.

Similarly, in men the coefficient of variation for energy drops from 34% to 24%, in children 48 to 72 months from 40% to 32% and in children 24 to 47 months of age from 37% to 15%.

Figure 1 illustrates the magnitude of the decrease in the variance of energy intake in mothers when 4 as opposed to one survey is used to estimate individual intake. The size of the variance when single evaluations are used is made to equal 100%. With two, three and four surveys per individual the variance drops to 62, 43 and 24% respectively of that obtained for single surveys. No further decreases in the size of variance are observed with more than 4 surveys per individual.

Tables 3 and 4 display the results of a second similar study which contrasted a combination of recording and direct weighing techniques with the 24-hour recall survey.

The coefficients of variations (CV) for protein and energy intakes of mothers and children decrease if more than one

Table 2: MEAN AND STANDARD DEVIATIONS OF CALORIES AND PROTEINS IN REPEATED EVALUATIONS IN THE SAME INDIVIDUALS

Age Group	No. of Cases		NUMBER OF SURVEYS PER INDIVIDUAL			
			ONE	TWO	THREE	FOUR
Adult Males	23	Calories	2801 ± 1067	2812 ± 861	2702 ± 699	2639 ± 657
		Protein	88.8 ± 36.4	92.3 ± 30.9	86.6 ± 24.0	85.2 ± 23.1
Adult Females	17	Calories	1869 ± 637	1852 ± 501	1860 ± 419	1796 ± 314
		Protein	59.7 ± 25.4	58.6 ± 19.8	58.1 ± 14.0	57.0 ± 12.8
Children 24-47 months	6	Calories	872 ± 320	829 ± 374	705 ± 127	713 ± 105
		Protein	23.2 ± 6.8	23.1 ± 5.8	19.8 ± 4.1	20.2 ± 4.5
Children 48-72 months	11	Calories	951 ± 390	981 ± 362	1036 ± 324	1085 ± 326
		Protein	27.5 ± 11.8	28.2 ± 11.6	30.5 ± 10.7	31.3 ± 10.1

FIGURE 1

VARIANCE IN POOLED ESTIMATES OF MOTHERS' CALORIC INTAKE

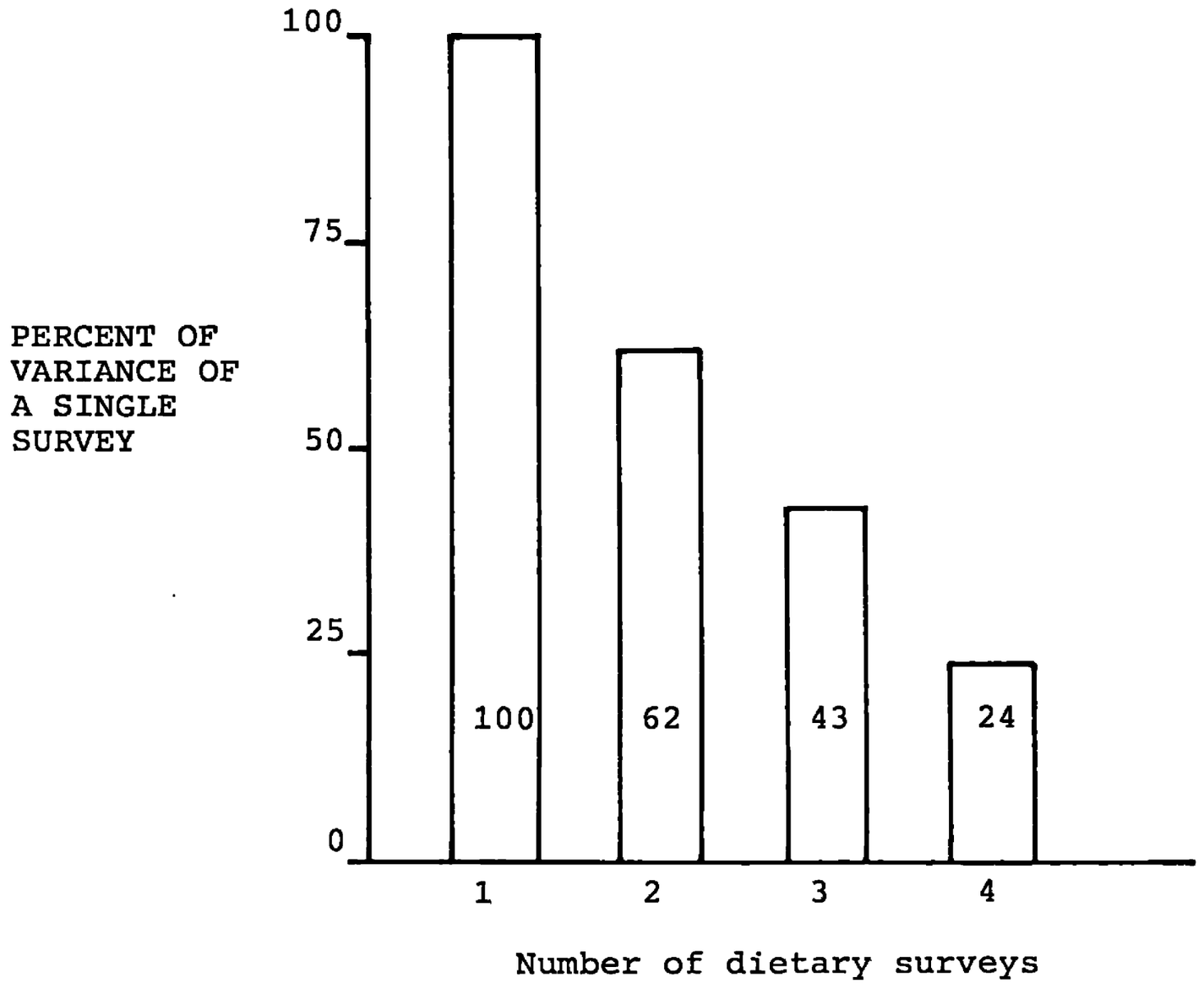

Table 3: MEANS AND STANDARD DEVIATIONS ($\bar{X} \pm$ S.D.) OF MATERNAL PROTEIN AND ENERGY INTAKE: THE EFFECT OF NUMBER OF SURVEYS PER INDIVIDUAL AND METHOD

Number of Surveys used to estimate usual intake	CALORIES		PROTEIN	
	Recording	Recall	Recording	Recall
1	1922 ± 577	2162 ± 592	57.4 ± 23.5	62.4 ± 18.8
2	1986 ± 433	2170 ± 547	62.1 ± 17.1	63.8 ± 15.0
3	1960 ± 409	2127 ± 439	61.7 ± 15.3	61.9 ± 12.9
4	1958 ± 354	2149 ± 420	61.3 ± 13.2	62.7 ± 12.3

Table 4: MEANS AND STANDARD DEVIATIONS ($\bar{X} \pm$ S.D.) OF CHILDREN'S PROTEIN AND ENERGY INTAKE: THE EFFECT OF NUMBER OF SURVEYS PER INDIVIDUAL AND METHOD

Number of Surveys used to estimate usual intake	CALORIES		PROTEIN	
	Recording	Recall	Recording	Recall
1	945 ± 298	995 ± 352	25.0 ± 10.1	27.5 ± 8.5
2	949 ± 311	945 ± 260	27.3 ± 11.2	25.4 ± 7.2
3	950 ± 305	922 ± 237	27.6 ± 10.2	24.6 ± 7.1
4	959 ± 279	916 ± 235	28.3 ± 9.3	24.6 ± 6.8

evaluation per individual is pooled. This is more obvious in mothers, as assessed by the recording method, where the C.V. of 30% for single evaluations drops to 17% when individual means of four diets are used. The differences between methods in this regard are minor.

The modifications in variance size of protein and energy by method, when observation in the same individuals are averaged were also analyzed in another study and results are displayed for mothers and children in Tables 2 and 3, respectively. Figures 2 and 3 illustrate the impact of the pooling of several observations in the size of variance attained. The highest variance of a single survey obtained for calorie intake of mothers and children in the 4 separate, weekly validation studies (see Tables 10 and 11) using the recall, have been given a value of 100%. They correspond to the second week for mothers (2182±675) and the first evaluation of children's energy intake (995±352). The variance of mothers energy intake drops to 66% when 2 evaluations are pooled, to 43% with three values for each mother, and to 38%, when four are used. For children, the size of variance for energy intake drops to 54% when 2 observations are pooled, 46% for three and 45% for four combined measurements of energy intake in the same children.

Table 5 displays test-retest correlations for energy and protein intake of mothers and children. Each individual value being correlated is the mean of two distinct assessments. For the recall method the test-retest correlations for energy were .61 in mothers and .51 in children while, for the recording method, they were .51 and .68, respectively. The test-retest correlations for protein intake of mothers and children using the 24-hour recall were .31 in mothers, and .51 in children. For the recording-direct weighing method, the values obtained were .29 in mothers, and .45 in children. Thus, there are no differences, by method, in reliability as ascertained by test-retest correlations.

In conclusion, the 2 studies have demonstrated the likely impact of several measurements of dietary intake in the same individual with respect to the reduction of other sources of bias which may be introduced when aiming to accurately ascertain the usual pattern of energy and nutrient intake of specific individuals. If under metabolic conditions energy expenditure is likely to have a coefficient of variation of around 10% in healthy individuals of the same sex, age group, and level of physical activity, then in such open communities as those of rural Guatemala with greater variations in energy expenditure, socioeconomic and environmental factors, a much greater coefficient of variation of intakes must be expected.

FIGURE 2

VARIANCE IN POOLED ESTIMATES OF MOTHERS' CALORIC INTAKE

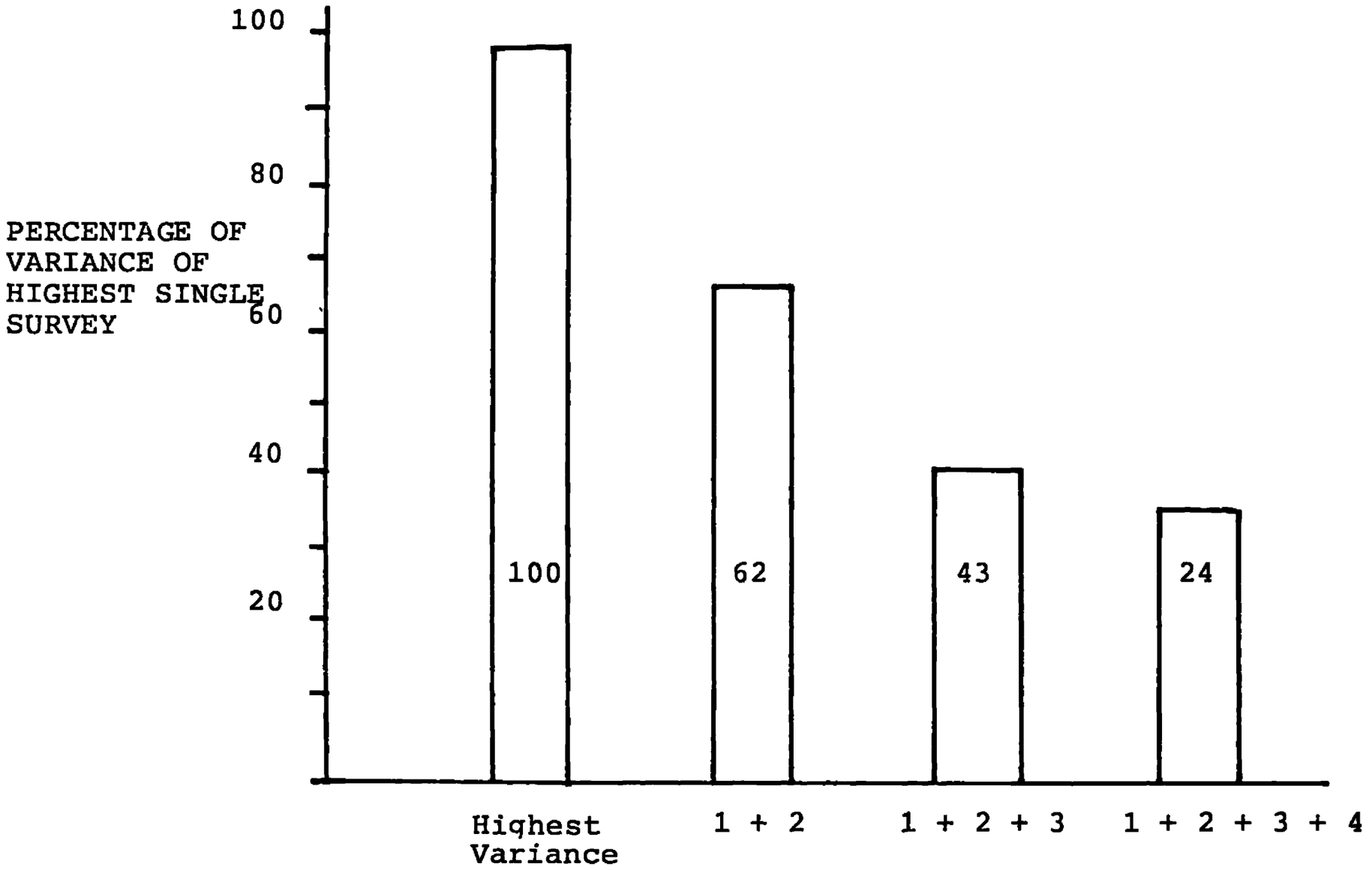

FIGURE 3

VARIANCE IN POOLED ESTIMATES OF CHILDREN'S CALORIC INTAKE

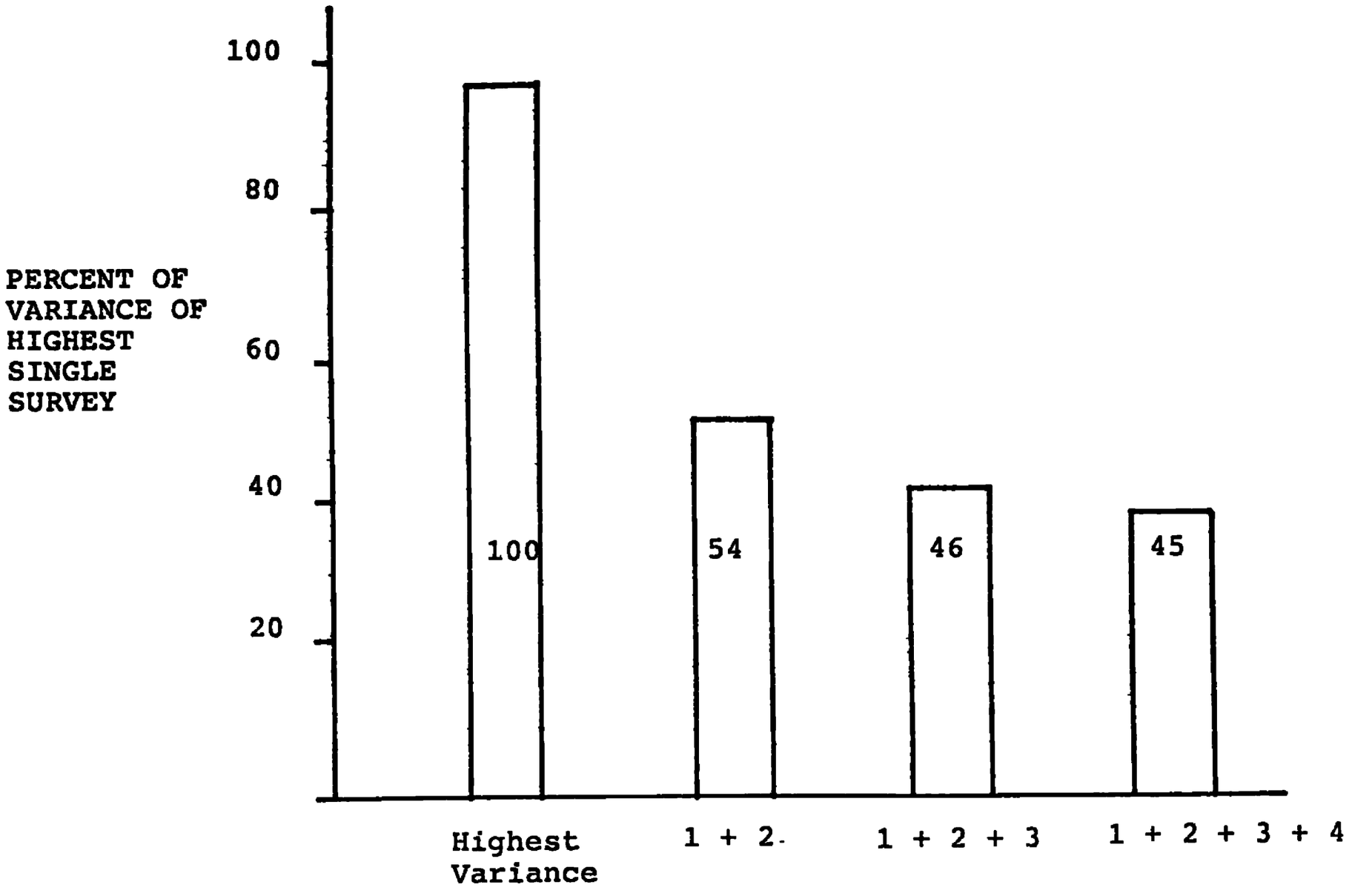

Table 5: TEST-RETEST CORRELATIONS FOR ENERGY AND PROTEIN INTAKE WHEN THE VALUES FOR EACH INDIVIDUAL ARE THE MEAN OF TWO ASSESSMENTS: RECALL AND RECORDING METHODS

METHOD	MOTHERS		CHILDREN	
	Energy	Protein	Energy	Protein
Recall	.61	.31	.41	.51
Recording	.51	.29	.68	.45

2.- Validation of the modified 24-hour recall as a measurement of dietary intake

This section will address survey validity from one special angle answering the question : Does the revised 24-hour recall method accurately measure group and individuals dietary intake ?

The research team undertook two studies to provide an answer to that question; the first, in 1977, in a sugar cane plantation 25 kms. from Patulul, and the second one in a coffee plantation 8 kms. from the same town. The major findings are described below.

a) First Study

i) Objective and Methods

The study was conducted to estimate, at the group and individual levels, the validity of the modified method when compared to a combined recording and weighing methods. The study also compared the results of the revised method with those of the 24-hour recall utilized in previous longitudinal studies at INCAP.

A total of 24 mothers and 18 children were visited and information on dietary intake was gathered through a combination of recording and direct weighing methods. The same families were visited the next day and diets were gathered in half the group by the traditional 24-hour recall method and in the other half by the modified method. In the second week all families were visited again for recording and direct weighing. For those families who responded to the traditional 24-hour recall the previous week, information was gathered through the modified method and viceversa. Information on tortilla consumption, in the modified method, was tabulated with the weights of the previous day and the weights obtained from tortilla models.

ii) Results

Tables 6 and 7 display the information on mean calorie and protein intakes for mothers and children, measured by distinct dietary methods.

There is generally a close agreement in mean calorie and protein intakes measured by direct weighing and the traditional and the modified recall methods ($p > 0.05$). There is a tendency in the modified recalls, to slightly overestimate protein intakes.

Table 6: MEAN CALORIC AND PROTEIN INTAKES OF MOTHERS STUDIED BY DIRECT WEIGHING AND THREE DISTINCT RECALL METHODS

Methods	Sample Size	Calories	Protein g
Direct weighing Modified recall (models)	20	1871 ± 470 1942 ± 508	59.6 ± 24.2 63.0 ± 25.0
Direct weighing Modified recall (direct weighing of tortillas)	23	1918 ± 510 1838 ± 490	59.4 ± 23.1 59.3 ± 24.5
Direct weighing Old recall	23	1713 ± 498 1644 ± 465	56.8 ± 21.3 57.1 ± 22.1

Table 7: MEAN CALORIC AND PROTEIN INTAKES OF CHILDREN STUDIED BY DIRECT WEIGHING AND THREE DISTINCT RECALL METHODS

Methods	Sample Size	Calories	Protein g
Direct weighing Modified recall (models)	16	887 ± 352 899 ± 345	23.3 ± 9.1 25.5 ± 10.3
Direct weighing Modified recall (direct weighing of tortillas)	18	863 ± 350 847 ± 365	22.8 ± 8.6 27.0 ± 10.2
Direct weighing Old recall	17	945 ± 360 942 ± 385	29.1 ± 10.5 30.1 ± 10.9

However these differences are not significant ($p < 0.05$).

The old recall methodology's mean values and the results obtain by the 2 modified recalls are in agreement with those derived from direct weighing.

Tables 8 and 9 present correlation coefficients between direct weighing and recall methods. Both modified recalls have higher correlations for calories with direct weighing than the traditional method. Correlations for proteins for traditional and modified are very similar for mothers and much higher in the modified methods for children. Finally, a correlation for calories for mothers was computed using the mean intake of two direct weighing measures and the mean intake of the old and a modified method (tortilla models), for the same individual. The value obtained was also high, 0.81.

iii) Conclusions

The data previously discussed suggest that recall methods are adequate for estimating protein and calorie intakes at the group level. Furthermore, the improvements in the traditional methodology have also produced a more accurate method for estimating intake at the individual level.

b) Second Study

i) Objective and Methods

The second study explored the possibility for the error detected in the previous validation exercise being random.

A total of 28 mothers with children ranging from 24 to 60 months of age were studied. The family was visited the first day, and the family's, mother's and children's diets are gathered by the direct weighing and recording methods. The next day a different interviewer visited the same family collecting the previous day's diets for the family, mother, and child, using the modified 24-hour recall method.

The same procedure was repeated four times with a week between each measurement thus providing four direct weighing and recording and four 24-hour recalls for each family member.

ii) Results

Table 10 presents the mean and standard deviation values for protein and energy from the weekly validations conducted for mothers. There is a tendency in the recall to overestimate the amount of calories consumed.

Table 8: CORRELATION COEFFICIENTS IN MOTHERS BETWEEN DIRECT WEIGHING AND THREE DISTINCT RECALL METHODS

Comparisons	n	Calories	Protein
Direct weighing and old recall	23	.56	.68
Direct weighing and modified recall[1]	20	.76	.64
Direct weighing and modified recall[2]	23	.84	.70

(1) Tortilla consumption determined through models.

(2) Tortilla consumption determined through direct weighing.

Table 9: CORRELATION COEFFICIENTS IN CHILDREN BETWEEN DIRECT WEIGHING AND THREE DISTINCT RECALL METHODS

Comparisons	n	Calories	Protein
Direct weighing and old recall	17	.55	.42
Direct weighing and modified recall[1]	16	.76	.70
Direct weighing and modified recall[2]	18	.65	.64

(1) Tortilla consumption determined through models.

(2) Tortilla consumption determined through direct weighing.

Table 10: ENERGY AND PROTEIN INTAKE ($\bar{X} \pm$ S.D.) IN 28 MOTHERS WHOSE DIETS WERE EVALUATED THROUGH THE RECORDING AND DIRECT WEIGHING AND THE RECALL METHODS IN FOUR DIFFERENT WEEKS

WEEK	CALORIES		PROTEIN (G)	
	Recording	Recall	Recording	Recall
1	1922 ± 577	2162 ± 592	57.4 ± 23.5	62.4 ± 18.8
2	2050 ± 504	2182 ± 675	66.8 ± 22.3	66.0 ± 18.3
3	1907 ± 589	2081 ± 469	60.9 ± 26.2	57.0 ± 16.1
4	1953 ± 484	2173 ± 583	60.1 ± 18.7	64.8 ± 23.1

This is a consistent pattern across week. The analysis of variance (ANOVA) controlling for nutrient, method and week showed that there is a significant difference given by the method for energy intake of mothers ($p < 0.05$) but not for proteins ($p > 0.05$). As opposed to the data for mothers, that displayed in Table 11 for children suggests that the recall tends to underestimate consumption of energy and of protein. The ANOVA in children does identify significant differences as a result of the method for protein ($p < 0.05$) but not for energy ($p > 0.05$).

Again, to determine accuracy of the revised 24-hour recall method at the individual level, use was made of the correlation coefficients for each separate assessment conducted every week by the recording and the recall. Furthermore, as our project gathered 3 to 4 dietary evaluations of the same subject in a given period of time, with the idea of pooling several observations to be related to other indicators of nutritional status, we have also estimated the correlation coefficient for pooled evaluations of 1 and 2; 1, 2, and 3; and 1, 2, 3, and 4 weeks. These data for mothers are presented in Table 12. It is interesting to observe the wide range of correlation coefficient values one can obtain if only an assessment or validation study is conducted. For example, in the case of women, and "r" of .33 was obtained in the fourth week, while an "r" of .63 was determined in the first evaluation. In the case of children (see Table 13), the variability of correlation coefficients in the 2 methods is even larger, from .24 in the first evaluation to .72 in the fourth one. However, one aspect is clear. When several evaluations are pooled, correlation coefficients determining the validity of the method for mothers and children are always close to or above .59, in terms of energy, or above .66 in terms of protein. According to the present analyses, where the above type of validations is considered as a "true" measurement of the capacity of the method to accurately measured real intake, at least 2 evaluations are necessary to measure the usual consumption. This is, however, the subject of further discussion in the next section.

3.- Validation of the 24-hour recall method as a measurement of nutritional status

Information on the methodological modifications, reliability and validity (accuracy) when measuring dietary intake of the dietary 24-recall method, have been presented in previous sections. A second approach for determining "validity", that is, the accuracy of the method for measuring nutritional status

Table 11: ENERGY AND PROTEIN INTAKE ($\bar{X} \pm$ S.D.) IN 28 CHILDREN WHOSE DIETS WERE EVALUATED THROUGH THE RECORDING AND DIRECT WEIGHING, AND THE RECALL METHODS IN FOUR DIFFERENT WEEKS

WEEK	CALORIES		PROTEIN (G)	
	Recording	Recall	Recording	Recall
1	945 ± 298	995 ± 352	25.0 ± 10.1	25.7 ± 8.5
2	954 ± 402	895 ± 334	29.6 ± 14.5	25.0 ± 10.3
3	953 ± 414	875 ± 304	28.1 ± 13.0	22.9 ± 8.3
4	985 ± 303	916 ± 343	30.7 ± 14.1	24.6 ± 9.6

Table 12: CORRELATION COEFFICIENTS (r) FOR ENERGY AND PROTEIN INTAKE OF 28 MOTHERS FOR A COMBINATION OF THE DIRECT WEIGHING AND THE 24-HOUR RECALL METHOD BY SEPARATE WEEKS AND AVERAGING SEVERAL WEEKS INTAKE

WEEK	ENERGY	PROTEIN
1	.63	.70
2	.44	.55
3	.53	.55
4	.33	.35
1 and 2	.66	.68
1,2 and 3	.66	.72
1,2,3 and 4	.74	.72

Table 13: CORRELATION COEFFICIENTS (r) FOR ENERGY AND PROTEIN INTAKE OF 28 CHILDREN FOR A COMBINATION OF DIRECT WEIGHING AND THE 24-HOUR RECALL METHOD BY SEPARATE WEEKS AND AVERAGING SEVERAL WEEKS INTAKE

WEEK	ENERGY	PROTEIN
1	.24	.36
2	.62	.73
3	.55	.62
4	.72	.41
1 and 2	.59	.72
1,2 and 3	.66	.71
1,2,3 and 4	.72	.73

is describe here.

This section will make use of food intake measurements and anthropometrical data for mothers and children gathered during the 24 month baseline period (see Appendix A) in order to determine whether the modified 24 hour recall method used in Patulul, measures individual nutritional status.

The main issues to be addressed in this section are :

a) Are dietary intakes modified as expected during pregnancy and lactation ?
b) Do dietary intakes vary as expected by age of children ?
c) Are dietary intakes related to growth rates ?

a) Dietary intakes during pregnancy and lactation

Figure 4 illustrates the modifications observed in energy intakes of mothers* during pregnancy and lactation. When mothers are divided by child's sex, Figure 4 shows that energy intakes during lactation are greater by as much as 300 kcal. per day than during pregnancy; a finding in close agreement with the higher nutritional needs found in lactation periods. Furthermore, the same figure demonstrates that energy intake peaks at 3 to 9 months after delivery, the time of maximal milk production and hence of greater physiological requirements. The energy intake and breast milk output of lactating mothers remain stable after the child reaches 12 months of age and no differences are found related to child's sex. The information available for protein intakes during pregnancy and lactation follows the pattern described for energy intake during the same periods.

The weight changes observed during pregnancy and lactation, which are shown in Figure 5, mirror the observed changes in mothers** dietary intake. Weight is lost in the first nine months after delivery. As noted above, both dietary intake and milk production reach a maximum at this time, indicating that the first six to nine months post-partum, are a time of great nutritional stress for the lactating woman.

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* Sample sizes in Figure 4 for mothers of boys range from 107 to 171 and for mothers of girls from 100 to 162.

** Sample sizes (Figure 5) are 81 and 121 for early and late pregnancy respectively for mothers of boys and 73 and 115 for late and early pregnancy respectively for mothers of girls. For mothers of boys, sample sizes during lactation range from 139 to 177 and for mothers of girls from 133 to 174.

FIGURE 4

MATERNAL CALORIC INTAKE DURING PREGNANCY AND LACTATION

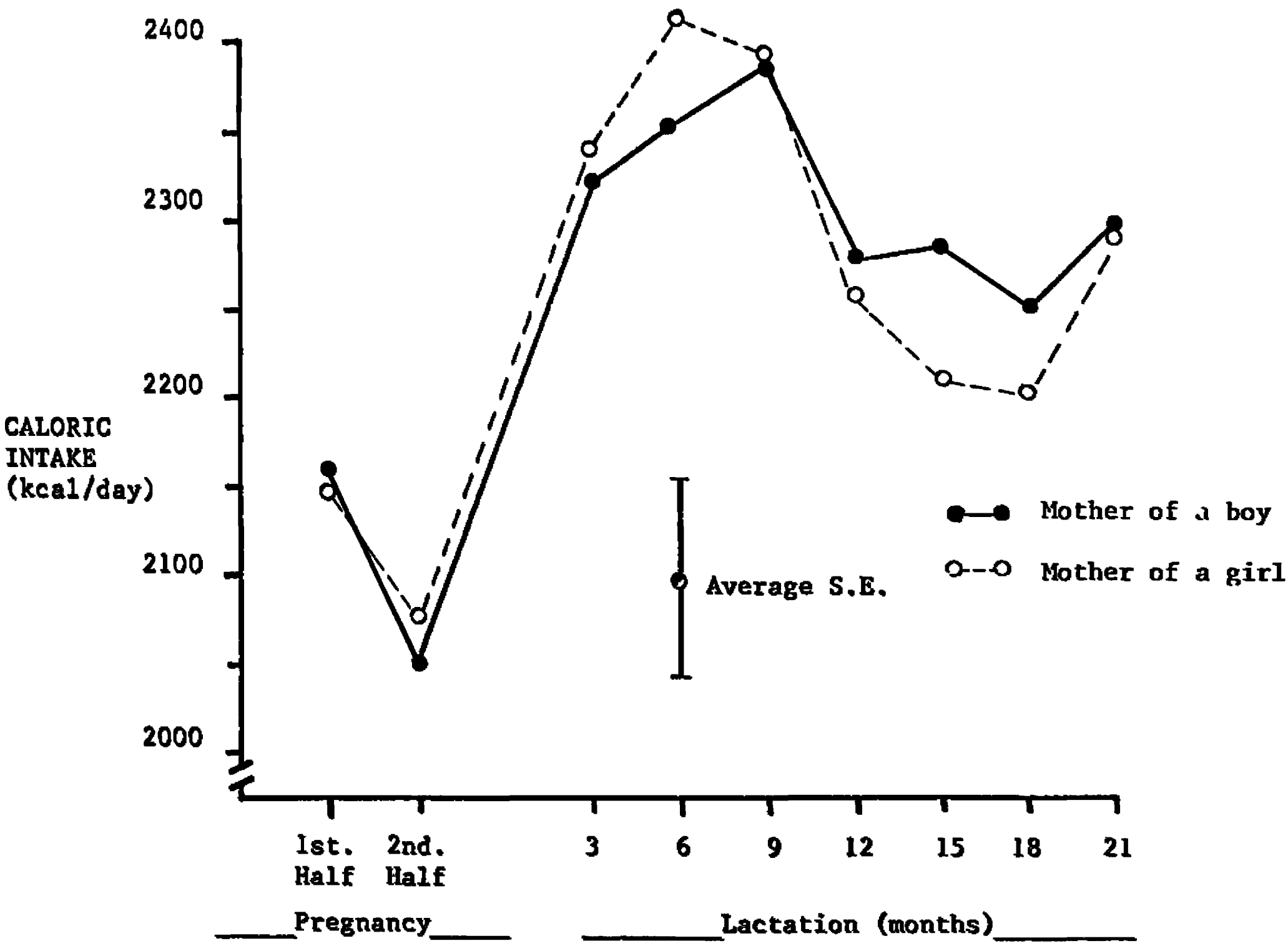
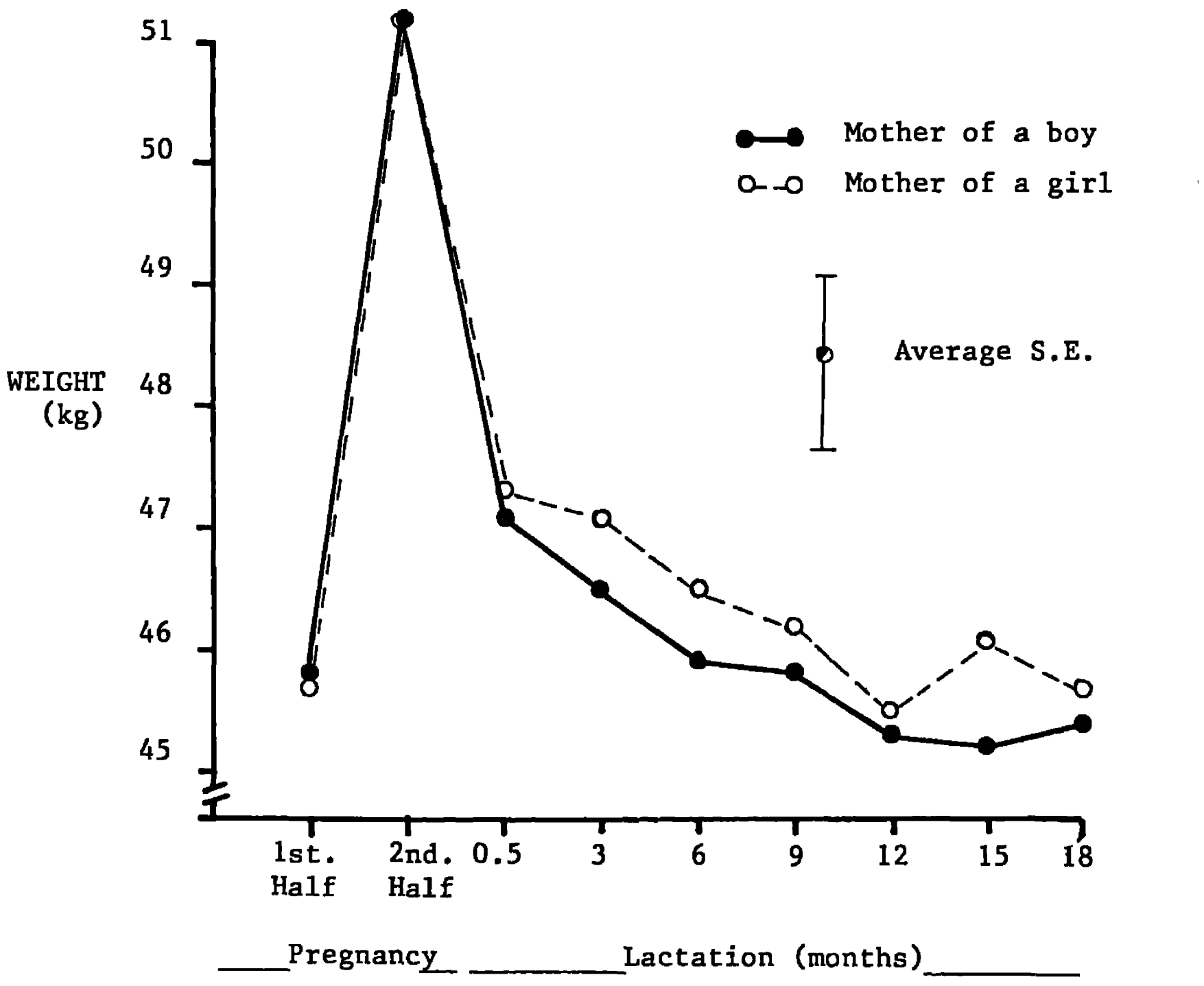


FIGURE 5

MEAN MATERNAL WEIGHT DURING PREGNANCY AND LACTATION



b) Dietary intake in children

The changes in intake in children* do vary, as expected, by age and sex as shown in Figure 6. At most ages, intake for boys is greater than that for in girls, and at 45, 51 and 57 months of age, the differences are statistically significant ($p < .01$). Moreover, the method finds that older children always have greater intakes than younger children and older boys, eat more than younger ones. These "common sense" patterns in the dietary data are consistent with expectations.

c) Dietary intakes and growth

We have been successful in modeling the growth data for children. For example, we show in Table 14, for each six months period, the pooled estimates of the regression coefficients in the eight largest groups (i.e. four largest fincas by sex). Separate estimates of the slopes within each group were made, tests of homogeneity were then carried out and a pooled estimate of the slope was finally generated. Furthermore, the regression coefficients (slopes) have been corrected for differences in initial size of the child and for variability in the time span between first and second child size measurements and for differences in the average date of collection of the dietary data.

The data in Table 15 present the following patterns.

While all of the slopes for weight are positive, two out of the 10 slopes for height are negative. In fact, for the period 0 to 6 months, where only a few children are consuming any food other than breast milk, the slope is negative and statistically significant. We interpret this finding as indicating that those few children consuming foods other than breast milk in the first six months, are likely to present more illnesses, to have poorer diets and hence, to exhibit poorer growth. It is also possible that higher intakes of supplementary foods are significantly related to the lack of adequate maternal lactation performance and those children are likely to have a lower energy and nutritient intake than full breast fed infants. Subsequent periods all point to a fairly consistent, positive relationship with growth in height, and even more so, with growth in weight. Finally, it should be noted that most of the slopes become statistically significant when corrected for attenuation. This correction involves dividing the slope by a test-retest correlation of diets of ($r=.5$). All but three of the slopes for height and four of those for weight become statistically significant after correcting for attenuation.

FIGURE 6

CHILD ENERGY INTAKE BY AGE AND SEX

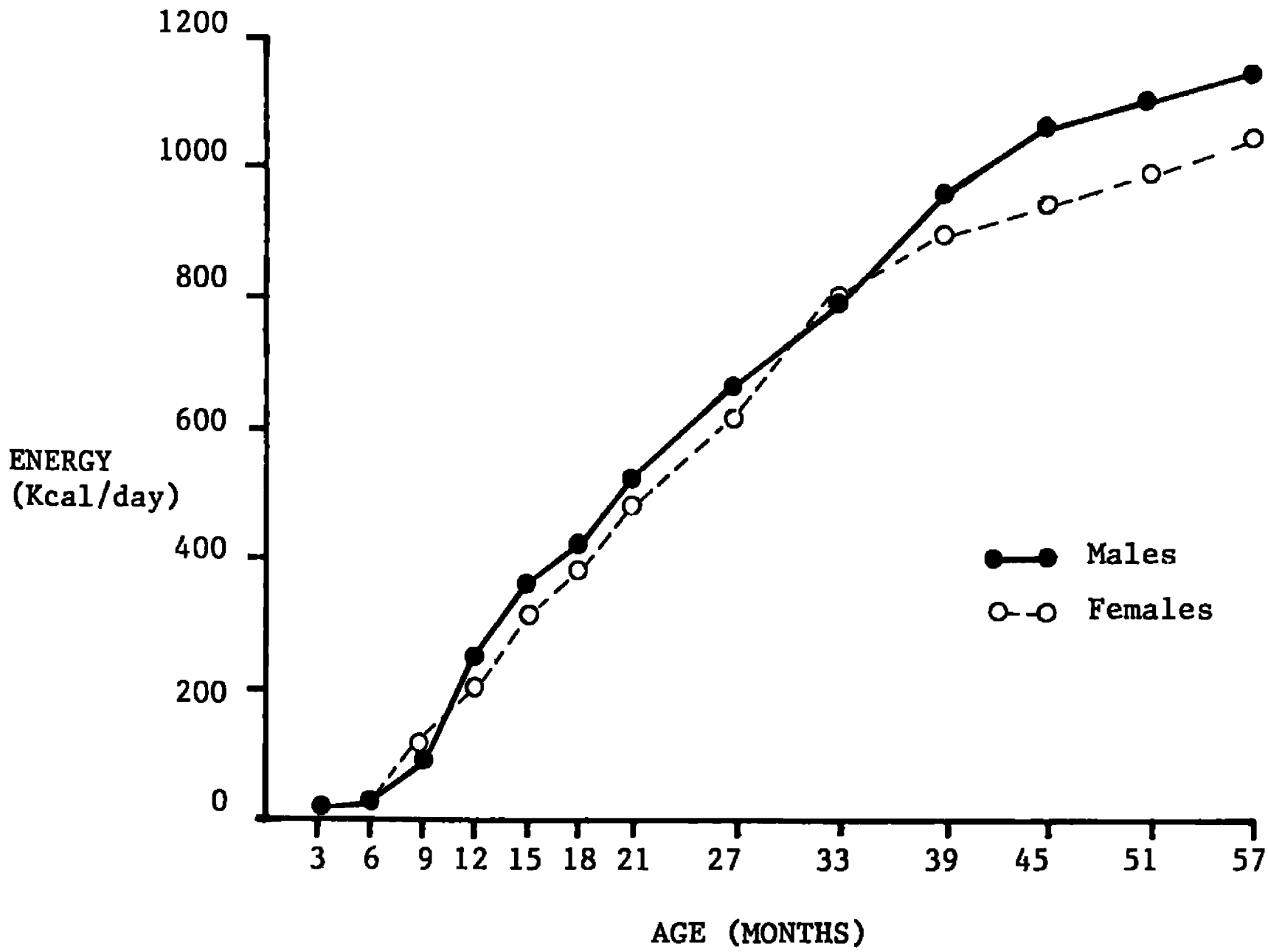


Table 14: RELATIONSHIP BETWEEN CHILD ENERGY INTAKE AND GROWTH INCREMENTS

Period (months)	Sample Size	Height Increments Slope (mm/100 kcal)	t	Weight increments Slope (g/100 kcal)	t
00-06	114	-8.06	-2.68**	25	0.20
06-12	105	1.27	0.98	81	2.40*
12-18	126	0.80	0.93	71	2.44*
18-24	137	-0.31	-0.52	17	0.65
24-30	120	0.27	0.29	12	0.34
30-36	110	0.94	1.38	30	1.01
36-42	103	1.55	2.54*	48	2.20*
42-48	106	0.91	1.43	20	0.70
48-54	117	0.24	0.43	15	0.65
54-60	117	1.01	1.63	42	1.55

The results were obtained through an analysis of covariance (BMDP-PIV). The slopes are pooled estimates of the values of eight groups (boys and girls of the four largest fincas). The slopes are adjusted for differences in initial size of the child, time interval between first and second height or weight measurements and average date of collection of the dietary data.

*p/.05, ** p/.01

Table 15: AVERAGE[a] REGRESSION COEFFICIENTS (SLOPES) FOR SIX MONTH PERIODS FROM 6 TO 60 MONTHS

INDEPENDENT VARIABLE	DEPENDENT VARIABLE	AVERAGE SLOPE	t
Child energy	Height increments	0.70 mm/100 kcal	2.69**
Child energy	Weight increments	37 g/100 kcal	3.83***
Child protein	Height increments	0.16 mm/g of protein	1.86*
Child protein	Weight increments	11 g/g of protein	3.39***

[a] The slopes (as shown in Table 14) were pooled as follows:

$$\sum_{i=1}^{k} n_i \; b_i \Big/ \sum_{i=1}^{k} n_i$$

The standard errors (for the calculation of t) were calculated as follows:

$$\sqrt{\sum_{i=1}^{k} n_i \; (SE) \sqrt{n_i)^2} \Big/ \sum_{i=1}^{k} n_i}$$

Where n=sample size; b=slope and SE=standard error.

* p/.10; ** p/.01; *** p/.001.

An interesting aspect of the findings is that it appears that the slopes are similar across ages. The pooled slopes across ages are shown in Table 15. Relationships with growth rates are shown for energy as well as protein intake. Clearly, the relationships are positive and statistically significant.

III DISCUSSION

Food consumption surveys in Patulul were designed to ascertain changes in energy and protein intake of mothers and children in order to relate the information, at the group level, with growth estimates. A revised 24-hour recall method for gathering food consumption data has been one of the major outcomes of the study, as growth can be predicted not only at the group, but also at the individual level.

The major improvements which were added to the traditional 24-hour recall method used in Central America are :

A) Aiding the informant's memory by collecting the data on family diet first, and asking directly about consumption of those food items likely to be overlooked by the interviewer.
B) Identifying and correcting sources of errors in the reporting of foods which represent the greatest amounts of energy and protein in the diet.
C) Collecting weights and measures of various products and cooking utensils in individual households.

Studies designed to ascertain the reliability and validity of the modified 24-hour recall demonstrate that the usual intake pattern for most individuals can be accurately measured, particularly when several evaluations of the same individual are averaged. For example, the size of the variance of a single evaluation is larger in the 24-hour recall than in a more accurate food consumption method, i.e., combination of direct weighing and recording. This suggests that an important error component is introduced with a single measuremente through the 24-hour recall. When two observations of the same individual are averaged, variance drops in the two methods but the decline is more dramatic in the 24-hour recall.

This suggests that, in the combination weighing and recording method, the effect of socio-economic factors and of infections on variance are minimized, while in the case of several evaluations by the recall method "regression to the mean" efects, infection processes and socioeconomic factors are better controlled, thus reducing the size of variance.

Another approach for evaluating the reliability of the 24-hour recall is to analyze the coefficient of variation (C.V.). For mothers and children the C.V. for energy and protein intake is approximately 25%, a value slightly higher than the one obtained in metabolic studies measuring individual variability of energy and protein needs. The estimates of C.V. are very similar in energy and protein in the 24-hour recall, and the most accurate food consumption method (weighing and recording), when more than a single observation per individual is used. As infections and economic constraints widen the distribution of energy and protein intake in the study population, the C.V. obtained are slightly higher than the ones reported from metabolic studies determining intersubject variability of energy and protein needs.

The other approach for assessing reliability has been the estimation of test-retest correlations utilizing an average energy and protein intake from the first and third weeks, and the average from the second and fourth weeks. Again, the results in mothers and children, when the 24-hour recall method is compared with the combination of recording and direct weighing, are not different with the new method yielding reliability values similar to those of the most accurate method.

A second aspect of reliability, where bias in the estimates of real food consumption can be introduced, is low coverage of the study sample as a result of difficulties in reaching the house, lack of cooperation by families, and unreliable records. While this is a subject of great concern in dietary surverys conducted in developed nations, we pointed out previously that in our communities this is of little importance, even in cross-sectional exercises.

The validity of a dietary method can be assessed by comparing the results of energy and protein intakes with measurements obtained for the same individuals in the same time period by a more accurate method. Another approach, critical to the objective of our study, is to determine whether the dietary findings with the method being tested, bear any relationship to other indicators of nutritional status, i.e., anthropometric measurements.

Validity in the context of this discussion should refer to the measurement of the usual intake pattern for individuals, which is not necessarily the information yielded by a single measurement of energy and protein intake.

The first study comparing energy and protein intakes ascertained by the 24-hour recall and the combination recording and direct weighing methods suggest that similar intakes are measured by the two methods in both mothers and children.

The correlation coefficients comparing individual intakes by the two methods show higher values than in any other reported validation studies. This suggests that the 24-hour recall method accurately measures the usual intake pattern for most individuals.

The findings of the second study which addresses the validity of the revised 24-hour recall method, where four measurements of mothers and children are available for each method, are not entirely in agreement with the previous findings. The analysis of variance indicates significant differences by method in energy intake for mothers and protein consumption in children. Furthermore, when the results of each weekly validation are analyzed separately, a wide variability in correlation coefficient values are found, i.e., from .24 to .72 in children's energy intake. The study indicates the danger of drawing conclusions about the validity of a given dietary method with information derived from a single validation exercise.

Correlation coefficient values above .60 and .70 are obtained when two or more observations per individual are averaged. Although those values may be considered inadequate to draw conclusions about individuals since only 50% $(.70)^2$ of the variance accounts for true variability, the real question is whether the estimates of energy and protein intake, accurately measure the usual intake pattern of most individuals, thus, predicting growth characteristics for mothers and children. The section devoted to the analyses of dietary intake and growth has shown that the dietary method is able to predict growth with the data making sense in terms of known facts about greater or lower energy and protein needs in certain age periods and/or physiological states.

Most investigators argue that diet surveys in field studies should not be expected to work at the individual level. However, the dietary survey method employed in Patulul does allow the prediction of growth at the individual level. In other words, a suitable tool has been developed for the task.

A 24-hour recall method conducted several times in the same individuals with the characteristics describe in the present report, can provide accurate estimates of the usual pattern of intake of most individuals studied, and we strongly recommend its use in large scale field studies where this type of information is essential. However, prior to initiating the data collection process, the usual pattern of food procurement, preparation and consumption should be well understood and backed up by validation studies where valuable insights in terms of recipes and values for conversion factors can be learned. The same studies will identify the type and magnitude of major errors as well as the likely modifications in the proposed 24-hour

recall methodology to ensure better estimates of energy and nutrient intake at the individual level.

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APPENDIX A

THE PATULUL STUDY

I) The Research Design

The Institute of Nutrition of Central America and Panama (INCAP) initiated a longitudinal study in July, 1976 in order to determine the relative importance of protein and energy as the main dietary constraints in poor communities consuming high quantities of cereals. The study received financial support from the Agency for International Development (AID) from July, 1976 until August 1980 and is known as the Patulul Project, after the name of the town where INCAP field headquarters are located.

The Patulul Project pursued the following objectives:

A) To determine the relative importance of energy and protein for populations with a high consumption of cereal staples. This was to be ascertained by looking at the community level effects of dietary changes in energy, in protein, and in both protein and energy; on birthweight, physical growth, and morbidity rates for children under five years of age; and weight changes in pregnancy and lactating women.

B) To compare the impact of corn and beans, Opaque-2 corn and a high energy cookie, on food consumption patterns, physical growth and morbidity.

The following hypotheses were studied:

A) The provision of protein alone will not lead to measurable community level biological impacts on growth and morbidity.

B) The provision of calories alone will lead to measurable community level impacts on growth and morbidity.

C) The provision of proteins and calories will lead to the same measurable community level impacts on growth and morbidity as is the case in the calorie intervention.

In order to address the research objectives and proposed hypotheses, the research design summarized in Table A.1 was implemented. The baseline period was completed in September 1979. The variables, the periodicity of data collection and quantitity of examinations are displayed in Table A.2.

II) The Study Population

A) Location and geographical characteristics

To facilitate the possibility of detecting changes in children's

and mother's growth as a result of the proposed design, the research team searched for stable communities with little or no out migration and with few differences in living socioeconomic characteristics, health and nutritional status. The area chosen was a coffee growing region located in the "Boca Costa" in the Department of Suchitepéquez, between the towns of Chicacao and Patulul, the latter is 118 kms, from Guatemala City.

The communities selected were 12 coffee plantations (fincas) with permanent resident populations ranging from 350 to 1600 inhabitants.

The Boca Costa is one of the eight natural regions of Guatemala that runs North-South from the Mexican to the Salvadorean border, and West-East from the end of the Coastal plains to the volcanic mountains.

The elevation of the Boca Costa ranges from 1,500 to 3,500 feet above sea level and has a mean annual maximum temperature of 33°C. Rainfall ranged from 25 mm. in March to 378.8 mm. in June of 1976. Soils are very fertile, and tropical and semitropical fauna and flora are found. A variety of plants and fruits such as coffee, sugar cane, tea, quinine, bananas, cardamom, pepper, citronella, and rubber are grown there with some land also being devoted to cattle raising.

B) Population Chacaracteristics

1) General Aspects

Two distinct groups are found in the plantations; permanent residents who live and work there throughout the year and are called "colonos" and migrant laborers or "cuadrilleros", who are usually hired for only one month during the coffee harvest season, August to December. The Patulul Study only followed the families of permanent residents, most of whom were born in the same plantations.

Eighty five percent of the families are of Indian extraction and 15% are considered "ladinos" with most residents speaking Spanish reasonable well. All farms have life styles, beliefs and attitudes similar to the highland Indian communities of Guatemala.

Around 90% of the families are Catholics and 78% of the heads of households are married or "living" together in stable units. Only 30% of the population over 10 years of age are literate. The medium rate, in years, of school attendance is 0 with a mean of 0.8 years.

All houses belong to the finca owner and generally built quite close to one another and are identical in construction within any one finca. There is variability between fincas in

style and in construction materials. Bricks, sticks or cement are utilized for walls and zinc, asbestos or tile for roofs. Some of the houses have cement floors.

Piped water is available in all eight fincas. Water is collected by families from any of several faucets or fountains spread throughout the fincas. Analyses of water quality showed heavy contamination with fecal materials. This is not unexpected, as latrines are not available and people defecate in open fields near their houses.

2) Food Acquisition and Economic Activities

Finca owners sometimes give their permanent workers small plots of land, a quarter of a hectare, to cultivate corn. Such an area usually meets only two months of the demands for corn and other staples, particularly because the best lands are not devoted to basic grains.

There is a variation among fincas in terms of food subsides given to workers.. Corn was sold in 1977 in La Torre at $2.08 per quintal (100 punds) and in Santa Adelaida at $4.00, while in La Patria 2 pounds are given free per labor day. The rest of the fincas sell the grain at the open market price which may vary from $4.00 to $12.00.

All fincas have at least one "mill" (nixtamal) where families take their corn every day for grinding. In some fincas this service is free while in others a price which ranges from $0.01 to $0.06 is charged.

There are small private stores in the fincas where articles such as salt, sugar, beans, rice, sodas, juices, candles, soaps, cigars and matches are sold. In some of the fincas third-class beek or pork is sold once or twice a week.

Every two weeks, on payday, vegetables, grains, clothes and household articles are sold in an open market.

Many workers raise a few chickens or pigs, but these are almost always sold and not used for home consumption. Some families also have small fruit and vegetable gardens.

The fincas selected for study are basically dedicated to coffee cultivation, an activity that occupies almost all available labor and which represents around 90% of annual family income.

Coffee farming requires considerable labor throughout the year but especially so during harvest time. Women as well as children participate in some of the less demanding tasks. When income is low, from July to August, a family composed of two adults, one adolescent and two children, earned $40 per month in 1977. However, during harvest time income goes up and the

same family may earn more than $100 per month. Owners also render interest free loans to permanent workers when they are in need of extra money, such as in case of death, baptisms or marriages of relatives. These loans are reimbursed by the workers through small installments paid every 2 weeks on payday.

3) Demographic Characteristics

The age and sex structure resembles that of many developing nations, wide at the bottom and narrow at the top reflecting, therefore, the youthful nature of the population (See Figure A.1) The median age falls in the 15-19 age groups and the dependency ratio is 0.96. This ratio is almost equal to that of Central America as a whole (0.98), one of the highest in the world.

Fertility rates are extremely high and the child/women ratio is 92.1%; that is, for almost every women 15-49 there is one child under 5 years of age. The crude birth rate is 49.6 and the general fertility rate indicates that in 1976, one out of every four women of child bearing age had a live birth.

4) Health and Nutritional Characteristics of Children

The Infant Mortality Rate was 160 per thousand and the 1 to 4 year mortality rate 36 per thousand for the period 1970-1975.

Cross-sectional anthropometric data gathered in 1976-1977, in children 0 to 60 months in age, demonstrate that this area exhibits one of the highest prevalences of growth retardation in Guatemala. The proportion of children with second and third degrees malnutrition according to Gómez et al was 46.9% while in a national rural anthropometric survey conducted in children 6 to 59 months of age in 1977 32% of children were found in the same two Gómez categories (22).

The high prevalence of growth retardation suggests that morbidity rates are similarly high. In fact, runny nose, cough, diarrhea, anorexia and fever had prevalences greater than 20% in children 0 to 24 months of age and greater than 14% in older children. These values are in general much higher than prevalences reported for other Guatemalan populations. The prevalence of diarrhea for 23.3% in children 0-24 months and 19.5% in older children, corroborate anthropometric information suggesting that health and nutrition problems in the fincas are of alarming nature.

TABLE A.1

RESEARCH DESIGN TREATMENTS (1,2)

TREATMENT	FARMS	TOTAL POPULATIONS	FOOD SUPPLEMENTS	EXPECTED CHANGES ON DIETS	EXPECTED CHANGES IN PHYSICAL GROWTH (4) (HEIGHT FROM 18-24 MONTHS)	EXPECTED CHANGES IN PREVALENCE OF LOW BIRTHWEIGHT (4)
Control	Luisiana (3) California (3) La Patria	379 618 884	None	None	None	None
Calories	La Torre San Francisco Los Andes	1308 664 289	High energy cookie	250 calories per family member per day. No additional protein	0.6 cms.	From 20% in baseline to 10% in the intervention phase
Protein	Mocá Santa Adelaida Potosí	1398 376 430	Replace common corn with Opaque-2 corn	5 g. of ideal protein per family member, per day. No additional calories	0.0 cms.	None
Calories and Proteins	Los Ujuxtes Panama	311 1063	More common corn and beans	250 calories per family member, per day and 7.6	0.8 cms.	From 20% in the baseline to 10% in the intervention phase

1) Phases: A) Baseline (24 months) from October 1977 to September 31, 1979
   B) Intervention (24 months) from October 1, 1979 to September 31, 1981
2) There is a group of 7 neighboring farms with a total population of 5,500 where anthropometry for all children o to 60 months of age is taken every 6 months. There receive no medical care nor any other type of intervention and are called the supercontrol farms.
3) Farms with only 9 months of baseline, January 1979-September 31, 1979.
4) Comparisons of intervened children with those from baseline period. Expected changes are derived from data available from a protein-energy supplementary feeding research project.

TABLE A.2

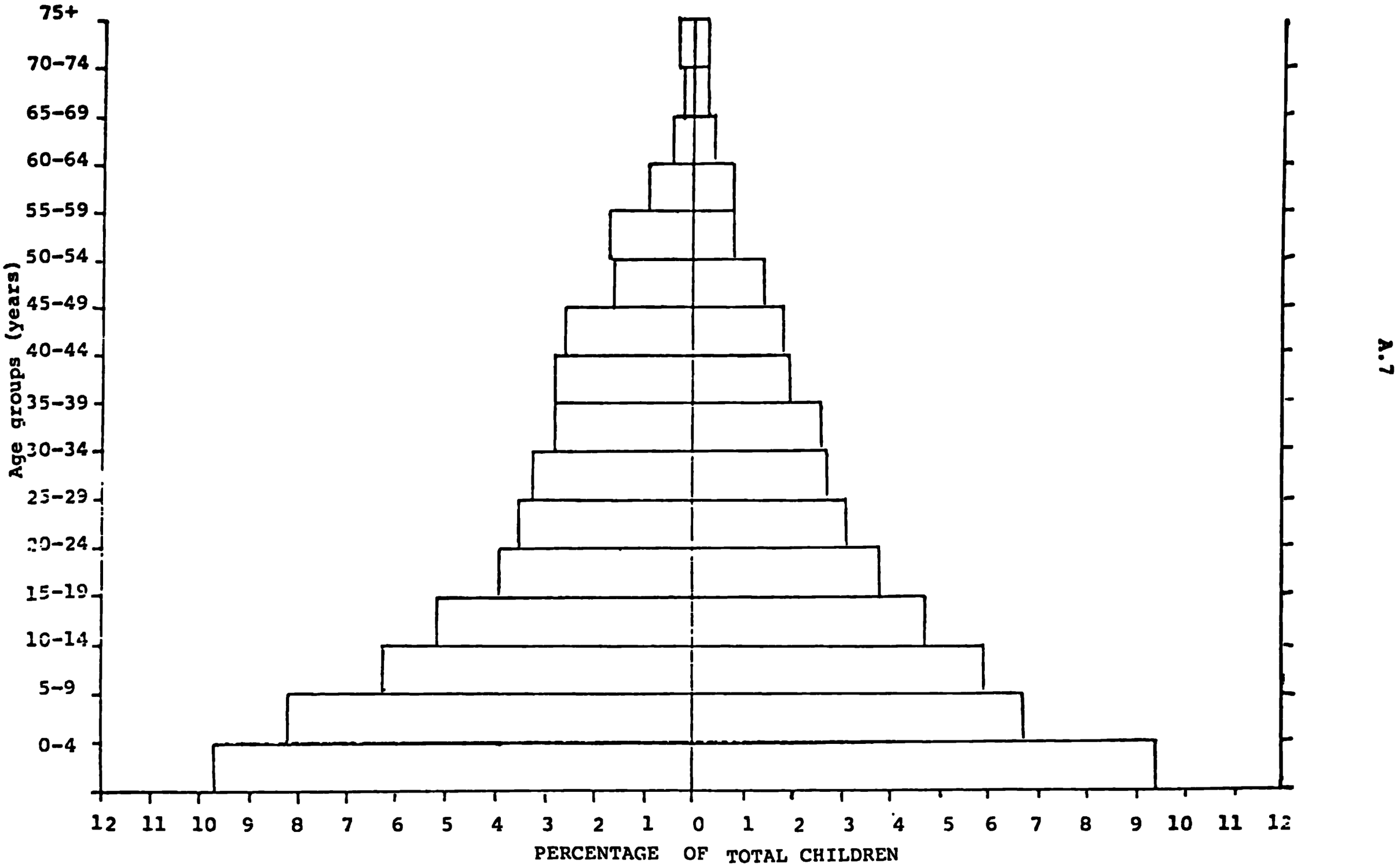
KINDS, PERIODICITY AND AMOUNT OF DATA DURING BASELINE

INSTRUMENT	VARIABLES TO BE MEASURED	PERIODICITY	No. OF EXAMS
24 hour recall dietary surveys	- Usual intake of children	Every 2 months	13,850
	- Usual intake of pregnant mothers	Every 2 months	1,724
	- Usual intake of lactating mothers	Every 2 months	7,291
	Growth of children	Children	
Anthropometry		Birth, 0.5,3,6,9, 12,18,24,30,36, 42,48,54, and 60 months	7,083
		Mothers	
	Maternal Antropometry	End of first, second, and third semester	1,025
		Every 3 months until 24 after delivery	4,280
Census	Birth, age, death, sex	Every three months	2,570 plus updating
Morbidity	Prevalence of diseases in children and in pregnant and lactating women	Every three months	2,112 (children) 1,404 (mothers)
Socioeconomic	Housing, education, occupation, family income	Every 18 months	2,570

Appendix A

FIGURE A.1

AGE-SEX STRUCTURE OF TOTAL FINCA POPULATION



APPENDIX B

STUDIES TO IMPROVE ACCURACY OF CORN CONSUMPTION EVALUATIONS

I) Introduction

The studies described in this Appendix were aimed at identifying sources of errors existent in the 24-hour recall method, particularly in terms of estimations of corn consumption at the individual level. Furthermore, they were designed to look for a suitable alternative method in order to improve accuracy of corn consumption evaluations for individuals included in the Patulul Project. Some of the results presented here have been the subject of a previous communication (23).

II) Materials and Methods

Sources of variability in tortilla weights were studied in a coffee plantations located on the mountain slopes facing the Pacific Coast of Guatemala. All families included in the present study were of Indian culture. Data available on children's health and nutritional status indicate high mortality rates, poor dietary intakes and marked stunting of growth (See Appendix A). As is usually the case in rural Guatemala, all families reported a daily consumption of tortillas. A family of two adults and three children may easily consume 100 or more tortillas a day.

Three studies were carried out to estimate the following sources of variance in tortilla weight: between family; between day; within family, between day; and within family, within day.

A) First Study

The first study was carried out to evaluate within-family variance in tortilla weight, as well as variability both within and between successive days. The design was as follows: one hundred and eighteen families, representing all families with children less than five years of age, were identified and randomly assigned to one of seven groups. The first group of families was studied for three consecutive days beginning on Monday, the second for three consecutive days beginning on Tuesday, and so on till the seventh group, which began on Sunday. The seventh group was larger than the rest because more surveyors were available on Sunday, Monday and Tuesday. Each family was visited for each of the three days by at least two different dietary surveyors who weighed at least 5 tortillas selected at random from all available tortillas with scales previously calibrated with brass weights. Tortillas were weighed together and the average tortilla weight was found by dividing by the number weighed. The families were allocated at random to each of the 10 surveyors who participated in the study. Table B.1 presents the number of families visited each day; the number of missing cases appears in parentheses. Missing cases were due to absence

from the house or lack of tortillas at the time the family was visited. Data for 337 family-days were obtained out of a possible 357, a coverage rate of 94.4%.

B) Second Study

Forty-two families, selected at random from the initial 118 families, were included in a second study designed to estimate variability between tortillas made on the same day by the same person. On a single day two tortillas were collected from each family, weighed individually in the field, placed in plastic bags and packed in ice and weighed again on more sensitive laboratory scales in the city. The contour of the tortilla was carefully traced and its diameter was measured. Because the tortilla were not always perfectly circular, vertical and horizontal diameters were measured and an average was calculated.

C) Third Study

The third study had three objectives: to estimate within-day variability among tortillas prepared by women in the morning and in the afternoon, to corroborate results between tortillas made on the same batch by the same person and to test how accurate women were in estimating the size of their tortillas from models of distinct tortilla sizes. A random sample of 30 families were selected from the original 118 for this study. Each family was visited in the morning and in the afternoon and during each visit, two tortillas from the same batch were collected, packed in ice and weighed on a scale in the laboratory. A surveyor returned the next day with three wooden boards. Tortilla models of size 2 (smaller) and 4 (larger) were represented on the first board in the form of flat discs. The second board had sizes 1,2, and 3 (the three smallest) while the third board had sizes 3,4, and 5 (the three largest). Size 3 was present in both the second and third boards. The woman was presented with the first model and asked which disc most resembled the tortillas she made in the morning or afternoon. If she answered that it was the second, she was shown the board with sizes 1,2, and 3 and the same question was asked again. Similarly, if her response was that it was size 4 that most resembled her tortilla, she was shown sizes 3,4, and 5 and asked again for her opinion.

III. Results

A. Sources of variability of tortilla size

The frequency distribution of tortilla weights in the 118 families of the first study is shown in Figure B.1. Each of the 337 values included, represents the mean weight of at least 5 tortillas. As was shown in Table B.1, most of the 118 families have values for three different days. The curve is, as expected, skewed to the right. The median tortilla weight is 43.4 g. and the mean and standard deviations are 45.7 and 12.0 g., respectively.

Values range from 19.6 to 94.4 g.

Figure B.2 shows the means and standard deviations of tortilla weights by day of the week for the same 118 families. Tortillas are heavier on Saturday, Sunday and Monday. Thus, Monday was significantly different from Wednesday ($t=2.51$, $df=93$, $p < 0.05$), Saturday was significantly different from Wednesday ($t= 2.72$, $df=79$, $p<0.01$),Thursday ($t=2.24$, $df=78$. $p<0.05$), and Friday ($t=2.34$, $df=78$, $p<0.05$). Similarly, Sunday differed signifcantly when compared to Wednesday ($t=2.90$ $df=96$, $p<0.01$), Thursday ($t=2.39$, $df=97$, $p<0.01$), and Friday ($t=2.47$, $df=96$, $p<0.01$). The largest mean difference is between Saturday and Wednesday, 5.9, or approximately six tenths the size of the pooled standard deviation.

The sources of variance in tortilla weight are presented in Table B.2. Within family variability is an important source of variance as it constitutes 51.9% of the between-family variance. Variability within the same lot is, however, low accounting for only 13.8% of the between-family variance.

Correlation analyses corroborate the data shown in Table B.2. The correlation between the weight of tortillas made on different days is 0.28 ($n=318$, $p<0.01$) for all possible pairs of the 118 families studied for three days. This indicates that the variability from day to day, within the same family is rather large.

Correlations of tortilla weights for the 42 families selected for both the first and the second studies are presented in Table B.3. The correlations between consecutive days are somewhat higher than those observed for the total sample, but similar in magnitude to those for days three weeks apart. However, the correlation between tortillas made on the same days at approximately the same time (the same batch) is very high, 0.86 ($n=42$, $p<0.01$) as ascertained from data collected in the second study. Tortilla makers are apparently very consistent once they decide what tortilla size they will be making at a given time.

Results obtained in the third study of variability within the same batch for both morning and afternoon tortillas are in close agreement with the results of previous studies. The correlation between the morning tortillas was 0.88 ($n=37$. $p<0.01$) and that between the afternoon tortillas was 0.91 ($n=37$. $p<0.01$). However, the correlation between morning and afternoon tortillas elaborated by the same family is much lower, 0.47 ($n=37$), a value that precludes the use of either weight of morning or afternoon tortillas as the only criteria for estimating consumption of tortilla for a whole day.

B. Elaboration and Evaluation of Models of distinct Tortilla Size

One way to circumvent the problem of large between and within-

family variance in tortilla weight is the use of models of distinct tortilla sizes. The procedure entails asking the woman to identify the model most similar to the tortillas she made in the morning and afternoon on the previous day.

In constructing the models, we first investigated whether differences in tortilla weight were explained by varying diameter and/or thicknesses. A plot of weight againts diameter is presented in Figure B.3. These data indicate that though diameter explains most of the variance in weight ($r=0.87$, $n=84$, $p/0.01$), thickness is also important.

Five initial models of tortilla sizes were chosen from the range of 19.6 to 94.4 g. The weights and diameters of the initial models are given in Table B.4. The first and last values, 20 and 71 g., were chosen to pick up the especially light and heavy tortillas (See Figure B.1). The second size, 39 g., includes the median (43 g.) found in the data shown in Figure B.1. The third and fourth values are intermediate.

Diameters were then estimated through the regression line found between weight and diameter ($W=76.9 + 9.69\ D$), where W and D are the weight and the diameter, respectively, of tortillas.

The ranges of weight which each model should cover in theory, are given in Table B.4. Sizes 1 and 5 exhibit the widest ranges but these are also the models with the least number of cases within the weight range.

Results of the evaluation of the models are presented in Table B.5. It is clear that the models were useful in classifying the tortillas according to their real weight. However, the models presented some problems. Women who chose models 1 and 2, underestimated the real weight of their tortillas. Conversely, women who chose models 4 and 5, overestimated the weights of their tortillas. Problems of underestimation of tortilla size are larger. In total, 44% of the cases were correctly identified within the ranges.

Based on the first experience, a second series of models of tortilla size were elaborated and validated with total diet in the field. Weights and diameters of the new models are presented in Table B.6.

The results of the study to validate the models with total diet in mothers and children are presented in Section 2 in the main text of this report. In summary, mean values for all mothers and children for calories and protein are slightly higher when results from models are compared with direct weighing. However, those differences are not statistically significant ($p/ 0.05$). Correlation coefficients between direct weighing and the 3 recall methods, showed that methods estimating corn consumption with tortilla models are likely to give better estimates for

individual surveys.

Correlations for diets gathered with the aid of models are always higher in calories and proteins when they are compared with diets collected using the old 24-hour recall method. Results from the 2 modified recalls, one using models and the other specific tortilla weights collected the day of the recall, for both age groups for calories and proteins are not very different.

The use of family specific weights elaborated from one measurement is problematic since families are not consistent from day to day in preparing tortillas of similar weight. This is clearly demonstrated in our studies by the low values of the correlation of weights of tortilla prepared on different days.

Problems of simplifying the process of gathering accurate tortilla weights are enhanced by the fact that tortillas are prepared in rural Guatemala at least twice a day, morning and afternoon, and the correlation between morning and afternoon tortillas for the same families is also low. The implication is that there is little use in obtaining and applying one value, either morning and afternoon, to all tortillas consumed in a given day.

There is, however, a very high correlation between tortillas from the same batch, prepared either in the morning or in the afternoon. This suggests that once mothers decide to prepare tortillas, their weights are going to be very similar.

Thus, the only way to achieve a precise estimate of tortillas is:

1) To weigh the morning and afternoon tortillas the day before the recall survey.

2) To weigh morning and afternoon tortillas for a series of days, generating a mean for each family and,

3) To make use of tortilla models.

The first solution, although precise, is time consuming for both the surveyor and particularly the informant. The last two need to be assessed frequently in order to determine precision and the level of biases which may be introduced at the individual level.

The results of evaluation of the first models suggests that they are valuable in ranking tortilla weights since mothers are able to discriminate among large, medium and small tortillas. This is a significant improvement over the use of mean village tortilla weights. Mothers showed, however, a marked tendency to underestimate the weight of small tortillas.

The evaluation of the second set of models with the total diet suggest that they are valid and accurate enough to est[illegible]te

tortilla intake at the individual and group level. Thus, their use to simplify the process of gathering dietary information in longitudinal studies in rural Mesoamerica, is strongly recommended.

TABLE B.1

SAMPLE SIZES FOR THE FIRST DESIGN

(Missing cases in parentheses)

Groups	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
I	12 (3)	15 (0)	14 (1)				
II		16 (0)	15 (1)	14 (1)	1*		
III			11 (2)	13 (0)	13 (0)		
IV				14 (1)	13 (1)	13 (2)	1*
V	1*	1*			13 (1)	11 (2)	11 (2)
VI	14 (1)	1*				16 (0)	16 (0)
VII	28 (2)	30 (0)					30 (0)
Total studied by day	55 (6)	63 (0)	40 (4)	41 (2)	40 (2)	40 (4)	58 (2)

* These cases represent situations where it was possible to obtain tortilla weights for the family 1 or 2 days later than planned.

TABLE B.2

SOURCES OF VARIANCE IN TORTILLA WEIGHT

Sources of Variance	Variance (g)	Percentaje of between-family variance
Between families (n=337 observations)	144.0	100.0
Within families* (n=318 pairs of observations)	74.8	51.9
Between tortillas made by the same person on the same day** (n=42 pairs of observations)	19.9	13.8

* Obtained through the following formula:

$$V = \frac{(a - b)^2}{2n}$$

where a and b are tortilla weights of all possible pairs within the family and n is the number of pairs.

** Weights obtained in the field are utilized. The correlation between weights determined in the field and in the laboratory is 0.99 (df=40, $p/0.01$). Moreover, there were no systematic mean differences between both measurements. This indicates that the field scales used in the first study were reliable and accurate.

TABLE B.3

CORRELATIONS* BETWEEN TORTILLA WEIGHTS MADE ON DIFFERENT DAYS

	DAY 1		DAY 2		DAY 3		3 WEEKS LATER	
	n	r	n	r	n	r	n	r
Day 1	--	--	39	0.50	37	0.52	41	0.48
Day 2			--	--	37	0.45	39	0.61
Day 3					--	--	38	0.49

* Days 1,2, and 3 refer to data collected in the first study for the 42 families later chosen for further study. Three weeks later refers to values collected in the second study.

All correlations significant ($p \leq 0.01$)

TABLE B.4

MODELS OF TORTILLAS OF VARYING SIZE

Size of Models	Proposed weight of model (g)	Estimated diameter (cm)*	Weight range (g)**
1	20	10.0	19.6 - 29.5
2	39	12.0	29.6 - 44.0
3	49	13.0	44.1 - 51.1
4	63	14.4	51.2 - 67.0
5	71	15.2	67.1 - 94.4

* Estimated from Figure 3 as follows: Diameter= (Weight - b_0)/b_1, where b_0 is the constant and b_1 the slope from the simple linear regression on weight on diameter.

** Ranges in weights which should be classified as belonging to a specific size. Size 1 begins 19.6 g., the lowest value, and extends to 29.5, the midpoint between sizes 1 and 2.

TABLE B.5

RESULTS FROM TEST OF VALIDITY OF PROPOSED MODELS

Models	n*	Mean weight and standard deviation (g)*	Percentage of cases in weight range***	Average deviation from model (x ± SD)***(observed minus model weight)
1	8	38.5±5.1	0.0	18.5±5.1
2	23	48.2±12.2	52.2	9.9±12.2
3	12	51.4±12.2	33.3	2.4±12.2
4	16	57.0± 9.4	62.5	-6.0± 9.4
5	14	63.5±16.8	43.0	-7.5±16.7

* Tortillas classified by mothers in different models.

** Cases correctly classified by mothers.

*** Average difference between real values classified in the model and estimated weight of the respective model.

FIGURE B.1 Percent Distribution of Tortilla Weights (n=336 family-day observations)

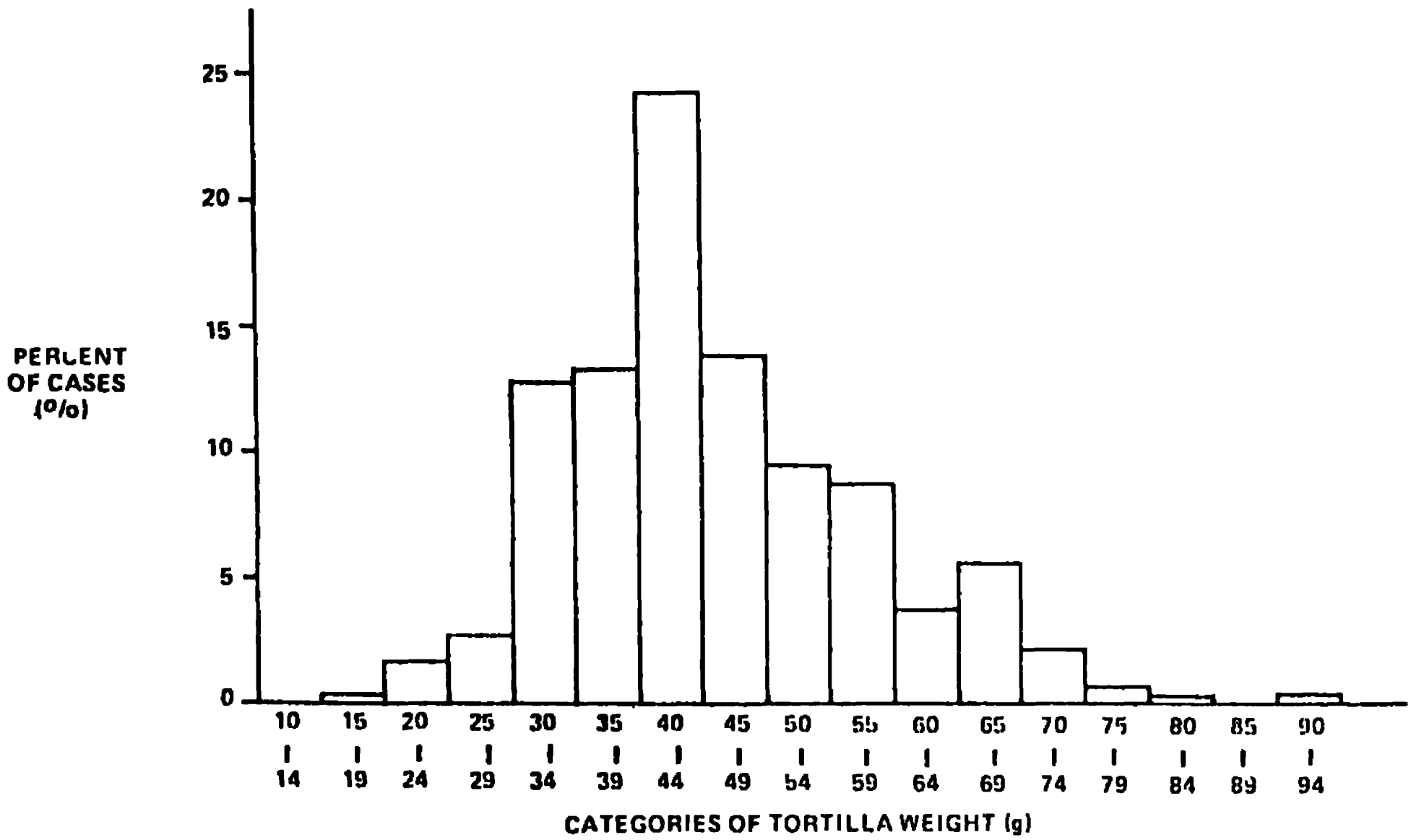


FIGURE B.2 Mean Tortilla Weights (g) by day of the week

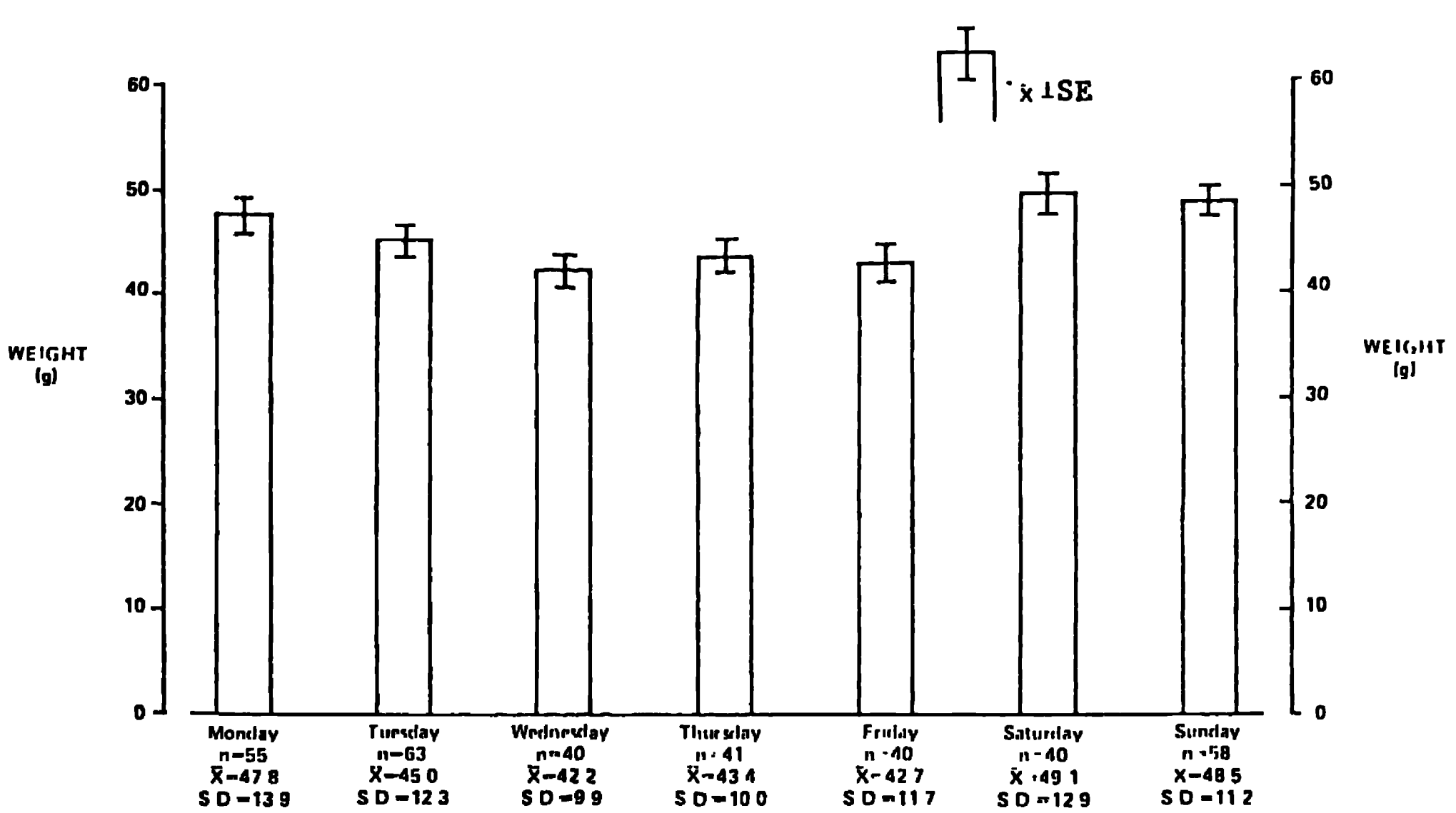
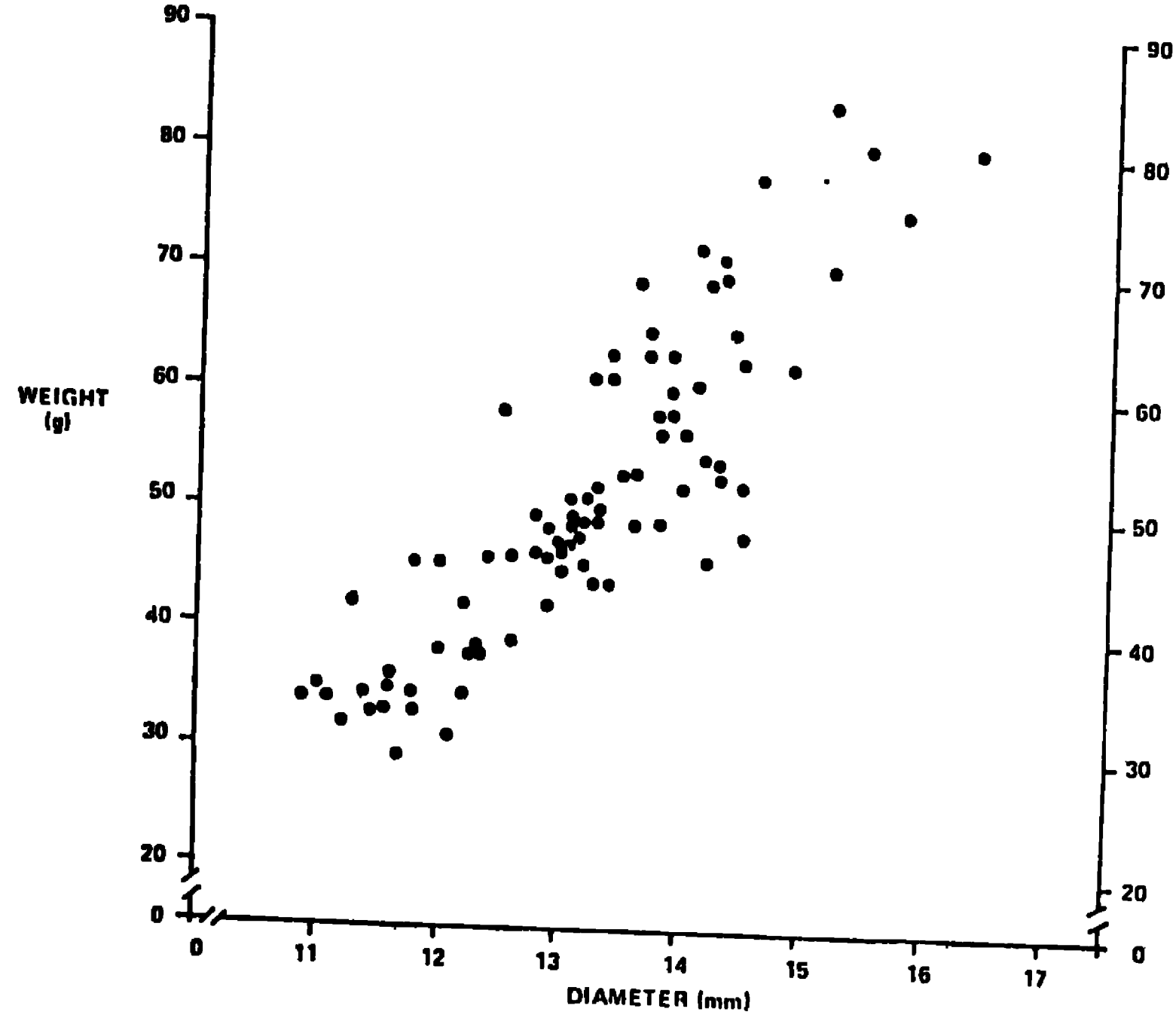


FIGURE B.3 Plot of Diameter (mm) against Weight (g) of Tortilla (n=84)



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APPENDIX C

DESCRIPTION OF THE FOOD CONSUMPTION METHOD

I. Introduction

The Patulul Project was organized to determine the impact of 3 nutritional supplements which provided additional energy, protein and energy and protein. The effect of these treatments was to be evaluated in terms of changes observed in physical growth rates of preschool children (See Appendix A).

In order to adequately measure the impact of the treatments it was deemed necessary to determine, as precisely as possible, the foods and the quantities of the same which are normally consumed by the study population, as well as the modifications resulting from the interventions which occur in the protein-energy content of these families' diets.

A modified 24-hour recall method which was refined to achieve greater precision and reliability in data collection has been used to collect dietary information for mothers and children.

This Appendix summarizes the present method and the information given to the field surveyors in order to explain the need for accurate measurement of energy and nutrient consumption.

II. Information given to field workers about the modifications in 24-hour recall method

A careful analysis of a traditional 24-hour dietary recall method brought to light 3 important sources of errors:

A) Informant's memory
B) Weight of tortillas
C) Weights and measures of other foods

A) Informant's memory

Often the mother does not remember all of the foods consumed by the other members of her family and, on occasions, the interviewer does not succeed in collecting information on all sources of calories and other important nutrients.

In order to avoid these problems, the interviewer must ask specifically about each meal and those foods which tend to be overlooked. Also, by asking about the family diet first and subsequently, about individual diets, the mother is able to remember the latter more accurately. Once the family diet has been established, the interviewer can use this as a reference point in order to investigate whether the individual's diet included everything listed for the family.

B) Weight for Tortillas

Errors frequently occur with relation to the weights and measures of foods. Traditionally, the average size tortillas for a specific community was used to calculate tortilla consumption in grams, for individuals. This was found to be inaccurate. Studies conducted in one finca demonstrated that tortilla size at the family level varies from 19.6 to 94.0 grams. If the mean, 43.0 g., were to be used for all families, the weight of the tortillas for many families would be under or over estimated.

The use of specific weights established in one tortilla making session also presents problems. From one day to the next there is a great difference in the size of tortillas made by the same person. Differences of up to 100% have been observed within the same family with weights of 32 grams to 65 grams being found on different days. Similar differences have also been observed between tortillas made in the morning and those made in the afternoon. This precludes the use of one weight for a specific family's tortillas. Nevertheless, the size of tortillas made at one session are relatively consistent; that is, if the mother decides to make tortillas of a certain size, all those made in that batch will be of similar weight.

In the Patulul Study specific data on tortillas size will be collected for each meal. The size will then be converted into grams based on a pre-established formula.

C) Weights and Measures of Other Foods

The utilization of various utensils similar to those employed by the study population (cups, glasses, spoons, etc.) for reporting of other foods, increases the accuracy of portion estimates. These figures are obtained for each family for a series of foods, and the units are then converted into specific weights or measures. For example, one spoonful of beans weighs 20 grams.

The method used for collection of family and individual diet information in the Patulul Project is described below.

III. Material and Methods

A) Sample and Periodicity of Data Collection

The study sample will include all mothers who have been pregnant in the past 5 years, or those who become pregnant during the study, and all children from 0 to 60 months of age. Diet information will be collected for each individual at 3 month intervals. Table C.1 presents the periodicity of data collection for mothers and children, and the number which corresponds to each interview.

B) Equipment

Each diet interviewer is supplied with a set of equipment which consists of: a Hanson or Maul scale, with 1 gram steps and a maximum capacity of 500 grams; cups, glasses, spoons, plates and models of tortillas of known weight. The scales are calibrated on a monthly basis by the diet interview supervisor. The results are to be analyzed every month by the professional and supervisor in charge; scales with more than 10% error are replaced.

Besides this equipment, the interviewers carry a series of forms to be filled out during the home visit. These forms are attached at the end of this appendix and are:

Form CD 1	Family Composition
Form 313	Family Diet
Form 317	Individual Diet Survey
Form 316	Food Weights

During each interview the surveyor brings the family weights and measures up to date and records them on the appropriate form. Thus, data is subsequently transferred to a control notebook.

C) The Interview and the Use of Weights and Measures for Tabulation

The interviewer take the equipment with her to each home visit and begins by gathering data on the foods and recipes consumed by the family the preceding day. Once the family diet has been established, individual diets are recorded. For family and individual diets the interviewer asks about specific times of day, i.e., from the time he/she got up until breakfast, breakfast, from breakfast until lunch, lunch, from lunch time until dinner, dinner, from dinner time until midnight.

The interviewer asks specifically about those foods mentioned in the family diet which do not appear in an individual's diet. If the informant does not report the following foods, the interviewer will ask about them: tortillas, "tamalitos", coffee, beans, green leafy vegetables, alcoholic and carbonated beverages, candies and fruits.

For tabulation purposes, the weights and measures identified for the family will be expressed in grams or ounces. The basic tabulations can be written in the corresponding section of form 317 enabling the supervisor to review them.

Based on her table of weights and measures, the interviewer checks to ensure that all foods with measures other than grams or ounces have the assigned measure.

Food recipes are recorded so as to include information about the ingredients used in their preparation, i.e., lard of oil used for rice, beans or eggs, sugar in coffee, etc.

During the study, some children will receive a special nutritional supplement from the clinic. The formula of this supplement should be included in the diet and thus the mother should be asked if any of her children are in this program and the quantity of supplement consumed. This information should be checked with that recorded in the clinic.

IV. Instructions for use of Forms

A) Instructions for use of Form CD1: Composition of Family Diets

Given that the family diet is distributed according to the number of persons consuming the same, a record must be kept of these data. The section of form CD1 from column 47 to 76 is used for this purpose. Columns 1 to 46 are used for census and details for completing this section are described in the census section of an Operational Manual available for the Project.

Column	Information
47-55	First surname of each member of the nuclear family
56-65	Second surname
66-76	First name of each family member

Diet: Attendance

The letters D,A, C and EC signify: Breakfast, lunch, dinner and between meals, respectively. In the corresponding columns, the following information is recorded:

0= If the individual was absent for this meal
1= If he/she was present and participated in the meal
2= If he/she was present, but didn't eat

Portion: In this section the number of portions corresponding to each individual according to physical status and age are recorded.

B) Instructions for Filling Out Form 313

Family Diet

This form is not precoded and is a worksheet to be used to register all data for the family diet.

The form's identification number is found at the top of the same. In the space which says "interviewer", this person writes in her initials. The day, month and year of the same is written where it says date of interview. The mother or informant's name is written in after the word family. The identification number for the finca is written in the first space with the family's

number in the second, and the mother's number in the third space.

In the space for breakfast, all foods and quantities used for this meal are recorded.

Portions: The number of portions distributed goes here
Lunch: Same as for breakfast
Portions: Same as above
Dinner: Same as for breakfast
Portions: Same as above
Between meals: Same as for breakfast specifying time of consumption

Any other pertinent information is included under observations.

C) Instructions for use of Form 317:

Individual Diet Survey

Column	Information
1-3	Form number: 317
4	Interviewer's code: each interviewer will have a specific code.
5	Family consumption of supplement provided by intervention.
6	Interview characteristics: 1) Not conducted due to informant's absence 2) Not conducted due to negative attitude 3) Reliable information obtained 4) Information obtained, limited reliability 5) Unreliable information obtained 6) Reliable, validated information obtained 7) Limited reliability of information. Validated. 8) Unreliable information. Validated.

Attendance:

0= Absent for this meal
1= Present and participated in meal
2= Present, didn't eat
3= Didn't eat due to illness

Name:

Name of individual for whom information

Column	Information
	is being recorded.
7-8	Identification of finca
9-11	Identification of family
12-13	Identification of individual according to position within family.
14	Sex: 1= Masculine 2= Feminine
15	Food consumption: 0= Absent 1= Ate at 3 principal meals 2= Present - didn't eat at one of three meals 3= Didn't eat due to illness, anorexia or modified diet 4= Food consumption outside of finca for one meal 5= Diet outside of normal limits: i.e., families who run a restaurant or have higher economic level
16-21	Day (16-17) Month (18-19) Year (20-21)
22-27	Individual's birthdate - Day (22-23) Month (24-25) Year (26-27)
28	Case identification 0= Pregnant mother 1= Pregnant mother with dietary supplementation 2= Mother, neither pregnant nor nursing 3= Infant or preschool child 4= Mother, neither pregnant nor nursing with dietary supplementation 5= Infant or preschool child with dietary supplementation 6= Mother in postpartum, lactation or post-lactation 7= Mother in postpartum, lactation or post-lactation period with dietary

Column	Information
	supplementation 8= Family Diet
29-30	Number of food items in individual diet.
31-32	Food Codes: the codes for the foods consumed in each and every meal according to the food composition table which is programmed into the computer for the Project.
	Food: in the blank spaces next to the word food, the names of the food consumed in each meal should be written.
34-36	Specification of food quantities consumed at breakfast. The first line will be used at the time of the interview to record all foods and the amount consumed. The following measurement codes should be used by the interviewer. 00= grams 01= large serving spoon 02= small serving spoon 03= soup spoon 04= tablespoon 05= tea spoon 06= plate 07= small plate 08= mug or glass 09= small mug or small glass 10= cup 11= penny's worth 12= unit 13= piece 14= small piece 15= large baby bottle 16= small baby bottle 17= handful 18= measure 19= chunk, "trozo" 20= small chunk, "trocito" 21= bunch 22= small bunch 23= stalk 24= plant 25= leaf 26= pod 27= head

Column	Information
	28= clove 29= soup bowl 30= bag 31= "tapa" special measure for unrefined sugar 32= piece of sugar cane 33= small basin, "guacalito" 34= package 35= small can 36= large can 37= shot glass 38= 12 lb. measuring box, "almud" 39= liter 40= bottle (375 ml) 41= pound 42= ounce 43= leg 44= leg and thig 45= neck 46= wings 47= half cup 48= small pitcher, "batidor" 49= slice, "rodaja" 50= tablet 51= at times 52= constant suction 53= medium can 54= small unit 55= medium unit 56= large unit 57= aluminum serving spoon 58= a little 59= a tiny bit 60= a box 61= large bag 62= small bag 63= medium spoon 64= small spoon 65= small handful 66= small gourd 67= large gourd 68= medium gourd

The following line corresponds to the food quantities tabulated in grams. Three digits should be used for each food. Example: If a mother reports that she ate yellow tortillas - 3 units #2* at breakfast, 6 units #2 at lunch and 4 units #2 at dinner, the information would be recorded as follows:

---

* This refers to tortilla model #2 which has weight of 39 g.

Code 31-33	D 34-36	A 37-39	C 40-42	EC 43-45	Total 46-49
Food: Yellow Tortilla					
444	3 u #2	6 u #2	4 u #2	--	--
444	135	270	180	--	0 585

Column	Information
40-42	Dinner: same as for breakfast and lunch
59-61	
43-45	Between meals. All foods consumed before and after breakfast, lunch and dinner.
46-49	Totals: The total amount, in grams, of each food consumed.

4. Instructions for filling out Form 316: Food Weights

Column	Information
1-3	Form number 316
4	Interviewer's identification code Name: Name of mother being interviewed
5-6	Blank
7-13	Finca identification (col. 7-8) Family identification (col. 9-11) Informant's identification (col. 12-13)
14-15	Blank
16-21	Day of interview (col. 16-17) Month of interview (col. 18-19) Year of interview (col. 20-21)
22-28	Blank
29-31	Food code according to computer's food composition table. Food: Specify food
32-33	Record code for measure used for specific food.

Column	Information
42-45	Average: record average obtained when dividing weight in grams (col. 37-41), by number of units weighed (col. 34-36).

E) Training of Personnel, Quality Control and Data Flow

1) Selection and Training of Personnel

The diet interviewers for the Patulul Project must have completed the equivalent of high school studies. The personnel is selected by the dietary survey supervisor. The first step in personnel training is the study of the pertinent sections of the Operations Manual and the Field Rules. Once the Operations Manual is understood, practice interviews will be carried out over a 3-day period in communities which are not included in the study. Subsequently the trainee will work with an experienced interviewer in the study fincas, for 2 weeks. During this time period, the trainee will be instructed in all practical aspects, from interview programing to data tabulation. Finally, the trainee will conduct interviews accompanied by the supervisor who will evaluate her performance and will determine whether she is prepared to assume full responsibility in the field. The training process will last approximately one and a half months.

2) Validation of 24-hour Recall Method and of Longitudinal Data

The 24-hour recall method used in the Patulul Study has been validated through comparison with data collected by means of combined direct weighing and recording. A study was conducted where in the first visit, the diets of 18 mothers and their children under five were evaluated by direct weighing and food recording. The next day, diet information was gathered by the 24-hour recall method. The results of this study indicate that the method is adequate for determination of average protein calorie intake at the group level, and for individuals.

Every month, 5% of the diet surveys are validated by the supervisor who make visits, at random, with the interviewer. Data collection forms are compared after the visit.

3) Standardization

Standardization of diet survey personnel is carried out in three different ways. Each interviewer is accompanied periodically by the supervisor who observes data collection. The supervisor corrects any differences in technique observed during the interview. Also the supervisor must observe and evaluate diet tabulation and work organization.

The second means of standardizing personnel is achieved by

a monthly review of the Operations Manual by the supervisor together with the interviewers. Any doubts are cleared up and interpretations are standardized. Any doubts or questions not answered in the Manual should be discussed with the professional in charge who, along with the supervisor, will decide whether modifications of the Manual are necessary.

The third standardization activity consists of review of tape-recorded interviews which will take place at bi-weekly standardization sessions.

4) Programing and Control of Coverages

A weekly work programing notebook is kept in each finca. This is reviewed every month by the supervisor. In this book the families whose diets have not been obtained are recorded with the reason for the same (negative family, emigrated, etc.) The negative families are then visited by the supervisor in order to determine the family's present status. The supervisor must also send a monthly report to the professional in charge of diets who together with the Field Director and the supervisor, will determine the strategy to be followed in dealing with negative families or any other source of information loss.

5) Data Flow, Cleaning and Incorporation into Files

Information collected at the finca level is sent to be perforated at the central INCAP Offices. Previous to this, the forms are reviewed and the information is tabulated by the interviewers and research assistants. The perforated and verified information is included in discs for analysis. Using a special program, the foods are converted into nutrients based on the Food Composition Table. The computer program allows the monthly information to be divided into 3 different data files:

1) Clean data files
2) Data with errors or outside of acceptable ranges of calories by age.
3) Clean data selected at random which should be reanalyzed by hand for program control and personnel training. Ten percent of the diets processed each month will be included in this file.

The data from the second and third files should be analyzed again and the necessary file modifications should be indicated.

INCAP – D.D.H. – PROYECTO PATULUL

ACTUALIZACION CENSO – DIETA **No.** 16564

• No DE FORMULARIO CD 1 (1 3) ENCUESTADORA ________ ____ (4)

IDENTIFICACION DEL PUEBLO ________ (7 8) No DE FAMILIA ________ (9 11) FECHA DE LA ENTREVISTA ________ NOMBRE DEL PUEBLO: ________

COD TARJ	[illegible]	IDENT SUJETO	SEXO	[illegible]	FECHA DE CAMBIO	FECHA DE NAC UR PARTO	PROCEDENC DESTINO	POSICION REAL	No DE CUARTO	No DE CASA	EDAD VERIF	EST CIVIL	COD MATER	TIPO TRAB	CORREC F NAC	1a APELLIDO	2a APELLIDO	NOMBRES	DIETAS ASISTENCIA				[illegible]
(5)	(6)	(12 13)	(14)	(15)	(16 21)	(22 27)	(28 31)	(32 36)	(37 38)	(39 41)	(42)	(43)	(44)	(45)	(46)	(47 55)	(56 65)	(66 76)	D	A	C	EC	

C.12

PA SEPT-78

COL (5)
1 PRIMER INGRESO
2 CAMBIO
3 CORRECCION

COL (6)
1 DENTRO DE LA MUESTRA
2 FUERA DE LA MUESTRA

COL (15)
0 PRESENTE
1 NACIMIENTO
2 INMIGRACION
3 CAMBIO DE VIVIENDA
4 ESTADO CIVIL
5 EMIGRADO TEMPORAL
6 DEFUNCION
7 MORTINATO
8 NUEVA FAMILIA
9 EMIGRADO DEFINITIVO

COL (42)
1 INF DUDOSA
2 CONFIABLE
3 VERIFICADA

COL (43)
1 SOLTERA(O) SIN HIJOS
2 SOLTERA(O) SIN UNION FORMAL
3 MADRE SOLTERA (PADRE)
4 MADRE SIN UNION ESTABLE (PADRE)
5 UNIDA(O)
6 CASADA(O)
7 SEPARADA(O)
8 VIUDA(O)
9 NO SE APLICA

COL (44)
0 PROBABLE PRENATAL
1 EMBARAZADA
2 LACTANTE
3 NO EMBARAZADA NI LACTANTE
4 ABORTO PROBABLE
9 NO SE APLICA

COL (45)
1 VOLUNTARIO
2 COLONO
3 EMPLEADO

COL (46)
1 - CORRECCION
BLANCO NO CORRECCION

INCAP – DDH. PATULUL

C.13

DIETA FAMILIAR
ENCUESTAS DIETETICAS

Formulario 313 Entrevistador _____ Fecha encuesta _____

Familia _____ Identificación ____ ____ ____

DESAYUNO

Porc.

ALMUERZO

Porc.

CENA

Porc.

ENTRE COMIDAS

Observaciones: _____

E. de R./9-X-78

INCAP–DDH. PATULUL

PESO DE ALIMENTOS
ENCUESTAS DIETETICAS

Form. 316
(1-3)

Examinador ____
(4)

NOMBRE: ____________________
IDENT: ________ (7-13) SEXO ____ (14) CODIGO ____ (15)
F. EXAMEN ________ (16-21) F. NAC. ________ (22-27)

Cod.		Medida	Número unidades	Peso grs.	Promedio
29-30-31	Alimento	32-33	34-36	37-41	42-45
__ __ __		__ __	__ __.__	__ __ __ __.__	__ __ __.__
__ __ __		__ __	__ __.__	__ __ __ __.__	__ __ __.__
__ __ __		__ __	__ __.__	__ __ __ __.__	__ __ __.__
__ __ __		__ __	__ __.__	__ __ __ __.__	__ __ __.__
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__ __ __		__ __	__ __.__	__ __ __ __.__	__ __ __.__

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P-2470

C.15

INCAP/DESARROLLO HUMANO/PATULUL **ENCUESTAS DIETETICAS - CONSUMO DE ALIMENTOS**

Form. 317 (1-3) **Examinador** ____ (4) **Consumo familiar** ____ (5) **Características Encuesta** ____ (6)

ASISTENCIA	D	A	C	EC

NOMBRE ______________________ **Caso** ____ (28)

IDENT.: __________ (7-13) **SEXO** ____ (14) **CODIGO** ____ (15)

F. EXAMEN __________ (16-21) **F. NAC.** __________ (22-27) **Alimentos** ____ (29-30)

Cod. 31-33	D 34-36	A 37-39	C 40-42	EC 43-45	Totales 46-49	Cod. 50-52	D 53-55	A 56-58	C 59-61	EC 62-64	Totales 65-68
ALIMENTO						ALIMENTO					
ALIMENTO						ALIMENTO					
ALIMENTO						ALIMENTO					
ALIMENTO						ALIMENTO					
ALIMENTO						ALIMENTO					
ALIMENTO						ALIMENTO					
ALIMENTO						ALIMENTO					

P-2500