Title

AVERAGE MILK AND MINERAL INTAKES (CALCIUM, PHOSPHORUS, SODIUM, AND POTASSIUM) OF INFANTS IN THE UNITED STATES FROM 1954 TO 1968: IMPLICATIONS FOR ESTIMATING ANNUAL INTAKES OF RADIONUCLIDES

Authors

Durbin, Patricia W.
Lynch, Jean
Murray, Sylvia

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Patricia W. Durbin
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DISCLAIMER

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PATRICIA W. DURBIN

with the technical assistance of

JEAN LYNCH and SYLVIA MURRAY

Division of Biology and Medicine, University of California
Lawrence Radiation Laboratory, Berkeley, 94720.

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ABSTRACT

Dietary intake is one of the parameters needed to test metabolic models relating radionuclide burdens to environmental contamination levels. With respect to ^{90}Sr, the tissues of greatest potential hazard are the infant skeleton and marrow, yet the dietary intake of infants is less well characterized than for any other population segment. Publication of heretofore unavailable market research data on recent trends in infant feeding practices and the completion of two large "in-the-home" metabolic balance studies with infants now make it possible to estimate the amounts and kinds of milks and solid foods fed to infants in the United States.

Pertinent information from balance studies conducted in this and other laboratories, dietary surveys, and market research was collected and summarized. The results were used to estimate the daily volume ± S. D. of milk product consumed by the average U. S. infant month by month from birth through the second year. Milk

*Work performed under auspices of the U. S. Atomic Energy Commission.

intake increases rapidly from about 350 ml per day at birth to 750 ml in the third week. It continues to rise to a maximum of about 840 ml per day at the end of the second month. This intake level is maintained through the sixth month, at which time nearly all infants are receiving some solid food. A decline begins toward the end of the sixth month, and by the tenth month milk consumption has fallen to 670 ml per day. A slower but steady decline ensues for the next 14 months, so that the milk intake of the 2-year old is about 530 ml per day.

Variation in milk intake is largely due to differences in appetite, growth rate, body size, and solid food consumption--between-child variation. In addition, the daily intake of each infant fluctuates--within-child variation. The standard deviation (between-child variation) of the average daily milk intake is about 25% for a large heterogeneous population, when measurements are averaged over enough days to eliminate daily within-child fluctuations.

Market research data defined the age trends and chronological trends in the kinds of milk fed to infants--human milk, ready-to-use low-mineral formula, evaporated milk, or whole cow's milk. In 1950, 5% of newborn infants were given whole cow's milk, 25% were breast-fed, and 70% drank an evaporated milk formula. By 1968 the fractions of infants breast-fed or drinking whole cow's milk had changed very little, but now 69% of newborn infants received ready-to-use formulas and only 5% drank evaporated milk formulas. The above feeding patterns persist through about the third month of age, at which time the switch from all other milks to whole cow's milk begins. Between 1950 and 1968 4% of 6-month-old infants were still breast fed, 71% had been shifted to whole cow's milk, and only 26% were taking a formula (mostly evaporated milk formula in the 1950's and mostly ready-to-use formula in the 1960's).

The average total calcium, phosphorus, sodium, and potassium taken daily in milk was estimated for the average U. S. infant month by month from birth through two years from the daily milk intakes estimated above, from the fraction of infants drinking each milk product at each month of age, and from the published mineral concentrations of each milk product.

The average amounts and kinds of solid foods eaten month by month were estimated from balance-study and survey results, and the average daily intakes of calcium, phosphorus, sodium, and potassium in solid foods were calculated from these intake estimates and the published mineral concentrations in infant foods.

A sample calculation of ^{90}Sr intake is presented for a cohort of infants born in the vicinity of New York City on 1 January 1965; it is based on (a) the calcium intakes in each kind of milk and food month by month through 2 years of age as developed in this paper, and (b) the published ^{90}Sr analyses of these milks and baby foods purchased in New York City during 1965 and 1966. The total calcium and ^{90}Sr intakes of this hypothetical group were lower than previous estimates based on different dietary assumptions.

INTRODUCTION

Contamination of the biosphere with man-made radioactive isotopes, particularly ^{90}Sr, stimulated development of metabolic models that could be applied to the infant and the aged as well as to the working adult. Low concentrations of ^{90}Sr could be measured in diet and bone (1, 2), but the parameters of the physiological pathway from diet to bone were poorly known. A simple model that avoided most of the unknowns was proposed by Langham and Anderson (3). In this model ^{90}Sr in bone was related to incremental calcium accumulation, to the measured concentration of ^{90}Sr in bone, and to the rate of increase of ^{90}Sr in the diet. A more refined version of this model was used to predict ^{90}Sr levels in the skeletons of persons of different ages on diets of varying ^{90}Sr content, and to assess the potential hazard of ^{90}Sr in the environment (4-7). The key factors in this metabolic model for ^{90}Sr are (a) the total dietary intakes of calcium and ^{90}Sr and (b) a discrimination factor that relates utilization of dietary ^{90}Sr to the utilization of dietary calcium.

Dosimetric calculations for ^{90}Sr in U. S. adults routinely assume an average calcium intake of 1 g/day (8); a calcium intake of 1.2 g/day is used for similar calculations in the U. K. (9). Several years ago the calcium intake of infants in the U. S. was estimated to be 1.3 g/day (10). This was later revised downward to a total intake of 1 g/day assuming 80% of dietary calcium was obtained from milk (11). The earliest estimates appear to have been based on dietary recommendations, either official (12) or in the popular press (13), rather than on information about actual infant feeding practices. Even the more recent estimate does not take account of the frequency of breast feeding, the frequency of use of low-mineral ready-to-use formulas rather than evaporated milk formulas, or the shift to fresh milk that takes place midway through the first year.

The discrimination factor is defined as the inverse of the Observed Ratio (OR), introduced by Comar et al. (14), in which

$$OR = \frac{Sr/Ca\ bone}{Sr/Ca\ diet} = \frac{\%\ dietary\ ^{90}Sr\ retained\ in\ bone}{\%\ dietary\ Ca\ retained\ in\ bone} .$$

OR has been measured in adult human beings (15), and the value obtained, OR = 0.25, has been widely used in interpreting annual samplings of foods and bone specimens (4-7). It was suggested that OR might be greater in animals on milk diets (14), and that OR in the human infant was probably greater than OR in the adult (16, 17). The U. S. Federal Radiation Council chose to use OR = 0.35 for children less than 2 years (8). A recent study by Kahn et al. (18) is convincing; the ^{90}Sr OR = 0.54 was measured in 30 infants observed continuously from 1 to 10 months of age. Kulp and Schulert (7) commented on the implications of OR > 0.25 in infants as follows: "If the discrimination factor is actually less than 4 [OR > 0.25 in children under 2 years old], then another factor such as systematic variation in the diet must be operative to compensate." Bracketed note added by us. A reevaluation of the average intake by infants of milk and various foods seemed to be in order.

At least three significant changes have occurred in infant feeding practices in the 15 years since hydrogen weapons testing first injected ^{90}Sr into the environment; (a) Homogenization of dairy milk, begun in the 1940's, is now common practice throughout the U. S., and homogenization along with improved refrigeration and distribution facilities have made digestible, bacteriologically safe dairy milk readily available for infant feeding (19);

(b) Prepared low-mineral ready-to-use formulas,* introduced in the mid-1950's, have almost replaced evaporated milk in the bottle feeding of the newborn (20); (c) Strained and chopped baby foods, strongly promoted and attractively marketed, are being fed to more infants at younger ages than in former years (21). Although each of these changes may not be as dramatic as the shift from breast-feeding to evaporated milk in the 1920's and the initial introduction of prepared baby foods in the 1930's, altogether they have effectively reduced the milk intake, reduced the mineral intake of artificially fed infants, and introduced local dairy milk into the U. S. infant diet at earlier ages.

This paper contains two kinds of materials; (a) published results of balance studies (18, 22-25) and dietary surveys (26-33), and (b) original unpublished data from two metabolic balance studies conducted in this Laboratory. The purpose of the balance studies was to determine the daily intake and output of ^{90}Sr and stable strontium, calcium, phosphorus, sodium, and potassium. These studies were conducted several years ago, but remained unreported because of the kinds of difficulties described by others (17, 18, 34). However, the feeding records permitted us to examine in detail the change with age of daily volume of formula drunk, the influence of solid foods on milk consumption, and the contribution of solid foods to both calorie and mineral intakes.

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*Most of the ready-to-use formulas [see Fomon (19) Ch. 11 for details] are made with diluted low-fat cow's milk. Carbohydrate and vegetable oils are added to replace the butterfat calories. Because of the dilution, the protein content is closer to that of human milk, and the mineral concentrations are roughly 65% of ordinary cow's milk products.

Market research data are reliable but rarely published. Fomon's recent book on infant nutrition (19) was a major breakthrough because it included heretofore unavailable market research data of Cox (20) on the frequency of breast feeding and the frequencies of feeding ready-to-use formula, evaporated milk, and whole cow's milk during the years 1958 through 1965. These data, along with information for 1965 through 1968 kindly supplied by G. A. Martinez (31), and the recently published results of another large at-home balance study (18) permit us to identify (a) the milk source, (b) evaluate the composition of the infant diet month by month, and (c) calculate the average daily intakes and integrated intakes of calcium, phosphorus, sodium, and potassium. The calcium intakes and annual ^{90}Sr and calcium analyses of dietary components permit us in turn to calculate the ^{90}Sr intakes of U. S. infants from birth through the second year.

METHODS AND MATERIALS

Synopsis of Original Data

Description of the Data. Our subjects were ten healthy Caucasian infants. Three were children of Laboratory employees and seven were children of students in the University married students housing facility. Each child was identified by both a number and the abbreviation of the milk product drunk; infants 1 through 5 were girls, and 6 through 10 were boys. The product abbreviations are EV, evaporated milk,* and PF-MO, Modilac.† Except for the twins, 7EV and 9EV, each infant was seen by a different pediatrician. The children lived at home and their mothers, who had all had either at least two years of education beyond high school or work experience, maintained the daily feeding records. Forms were provided on which to record formula composition, the amount of formula taken at each feeding, and the varieties and amounts of solid foods taken at each feeding. A Laboratory employee visited each home twice a week to pick up soiled diapers and excreta, to deliver milk and food, and to check the feeding record.

Milk was measured by using the graduations on standard 8-fl-oz nursing bottles. The full 8-oz graduation and the intermediate graduations above 2 oz were accurate to ±5%.

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*Evaporated milk (EV), purchased from the Carnation Co., had been processed at Gustine, California.

†Modilac (PF-MO), marketed by the Gerber Products Co., Fremont, Michigan, had been processed at Gustine, California, from 1959 through 1963. Since 1963 Modilac has been processed at Clear Lake, Wisconsin.

Solids were first recorded in standard measuring teaspoons or tablespoons, then as intake increased, were recorded in fractions of cans or cans per meal. Partly used cans were returned to the refrigerator and offered at succeeding meals until emptied. Dry cereal was measured in level spoonfuls and mixed with formula from the bottle used for that feeding. Each feeding was recorded separately, but excreta were pooled for 14 days. To avoid confusion with future reports on the metabolic aspects of these studies, intakes, except formula volumes, were also reported as 14-day totals or 14-day averages [14-day average = (14-day total/14)].

The three girls and four boys in the EV experiment were given a formula made with canned evaporated milk. Cases of milk from a single job lot (130.5 ± 3.4 mg Ca per 100 ml of a 1:1 dilution) were given to the mothers free of charge. This was the sole source of milk during a two-week equilibration period and the balance studies. Infants enrolled in the experiment before birth were fed formula made with this EV lot upon their arrival at home. Dilution of the EV and the amount of carbohydrate added were determined by the individual pediatricians. Balance studies were conducted for six consecutive 2-week periods beginning when the infants were 18 to 35 days old.

The two girls and one boy in the PF-MO experiment were given a processed liquid cow's milk formula. This study was intended to last longer than the shelf life of a single lot of EV. PF-MO was selected because it has a long shelf life, and its composition is controlled. In addition fewer formula composition changes were anticipated because at the normal 1:1 dilution, this formula is suitable for the new-born.

Four lots of PF-MO were used in the experiment: lot I (82.1 mg Ca per 100 ml of 1:1 dilution), six or seven 2-week balance periods beginning when the infants were 27 to 34 days old; lot II (81.4 mg Ca per 100 ml of 1:1 dilution), four 2-week balance periods beginning when the infants were 167 to 182 days old; lot III (83.7 mg Ca per 100 ml of 1:1 dilution), four 2-week balance periods beginning when the infants were 311 to 323 days old; lot IV (75.1 mg Ca per 100 ml of 1:1 dilution), four 2-week balance periods beginning when the infants were 446 to 462 days old. PF-MO was fed exclusively until the end of the last balance period. Enough of each lot was provided to supply all the milk needs of each infant for a span of time from 2 weeks before the start of a set of balance trials until 2 weeks before the start of the next set of balance trials, at which time the new lot was substituted, and the remainder of the preceeding lot was returned or diverted to other uses in the household.

All solid foods were produced by a single manufacturer at a single plant.* In the EV study the mothers purchased only this brand. In the PF-MO study solid foods were furnished by the Laboratory. Except for a few items of high calcium content such as cottage cheese, creamed spinach, and strained chicken the mothers selected supplies freely from the processor's list. During the last balance periods of the PF-MO study, when the infants were more than 1 year old, some adult table foods were added to their diets; these were eggs, crackers,

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*The Gerber Products Co., through its research director, Dr. Robert A. Stewart, kindly supplied the Modilac and the solid foods (processed at San Leandro, California) used in the PF-MO study.

shelf bread, bananas, apples, fresh fruit, frankfurters, ground beef, and cheese. Only the eggs, baked goods, and fruit were fed in significant amounts.

Samples of the milk products and solid foods, including the table foods, were dried, ashed, and analyzed for calcium in duplicate samples by a gravimetric method (35). Additional samples were prepared until two agreed within ± 0.5%. The calcium analyses of EV, PF-MO, and solid foods were within ± 5% of published values (36-38). The good agreement between the analytical calcium values and those determined by others led us to calculate phosphorus, sodium, and potassium by using recorded intakes and the processor's analyses (36, 37).

Total milk intake during each 14-day balance period was obtained by summing the individual feedings. After correction for a dilution different from 1:1 when needed, total mineral intakes in milk were calculated. The number of spoonfuls or cans of each solid food item were summed for each 14-day period and the mineral content calculated. Total bulk and total mineral intake of the four categories of solid foods were calculated by summing the appropriate individual items.

Daily Intake of Formula. The daily milk formula intakes of the ten subjects (grouped by 30-day intervals as numerical frequency distributions) are tabulated in Appendices 1a through 1e. Summaries of the milk consumption of the EV and PF-MO groups are included in Tables 1 and 2 and Figure 1. From 15 to 130 days the mean (and the median) milk intake of all ten infants was 740 ml per day (68% of values lay between 615 and 850 ml). Between 167 and 511 days the mean daily milk intake of the PF-MO infants was 630 ml (68% of values lay between 550 and 770 ml).

Daily formula records of 8 or more days in any 30-day interval between 15 and 130 days of age were available for 23 child-months in the EV group and 11 child-months in the PF-MO group. In seven of eleven cases the mean volume of PF-MO drunk agreed within ± 1 S.D. with the consumption of EV by infants of the same age. Child 1MO, who was fed unusually large amounts of solid food from 11 days of age, accounted for three of the four instances of disagreement. Therefore, for the remainder of this paper it was assumed that EV and PF-MO were equally satisfying, and that the differences in their compositions were not great enough to influence the volume consumed.

Milk consumption by the boys was slightly higher than that by the girls, as has been noted by others (24-26). Solid foods were withheld from two of the five boys, while at the same ages, two of the five girls were receiving large amounts of solid food, tending to exaggerate differences between the mean intakes of the boys and girls in this small sample. If these four unusual children were omitted from the means, the daily milk consumption of the boys was 757 ml and that of the girls was 714 ml during the age span from 15 to 130 days. Boys were above the grand average in 9 of 11 cases and girls were below the grand average in 9 of 12 cases.

Only a few of the frequency distributions of daily milk volume exhibited a sharp peak representative of a highly preferred intake, and these were restricted either to the earliest ages or to the infants who ate very little solid food. Most of the distributions were characterized by a central plateau 50 to 100 ml wide. The combined distributions for several infants tended to be more symmetrical than the individual distributions, but their central plateaus were broader (150 to 200 ml). Except for the period from 446 to 518 days, in which two individual distributions were bimodal, both the individual and combined distributions were normal and nearly symmetrical.

<u>Solid Food Intake.</u> The individual intakes of four categories of solid foods--cereal, fruit and juices, vegetables and combinations, and meat and egg--are shown in Appendix 2 as totals for each 14-day balance period. The average daily solid food intake of all ten infants (averaged over 30-day intervals) is included in Table 3. Midway through the second month, half of our subjects were receiving juices, strained fruits, and dry cereal mixed with formula. Vegetables were added in the third month, and strained meats and meat and vegetable combinations were added somewhat later. By the end of the third month eight of our ten subjects were taking 50 to 200 g of solid food daily. After the tenth month solid food intake ranged from 250 g to as much as 1,200 g per day. Infant cereal was fed in substantial amounts from the third through the twelfth

month, with maximum use in the fifth and sixth months. Very little infant cereal was fed after the twelfth month. The large S. D.'s of the intakes of the various solid foods, sometimes exceeding 100%, reflect the great variability in child preferences, and the skillfulness and determination of the mothers in the feeding of solid foods.

Mineral Intakes. The individual intakes of calcium, phosphorus, sodium, and potassium in milk and in four categories of solid foods are tabulated as 14-day totals in Appendices 4 through 7. The average daily intakes of calcium, phosphorus, sodium, and potassium in the four categories of solid foods are shown in Tables 4 through 7. Total intakes ±S. D. of the four minerals are plotted as functions of age in Figures 2 through 5.

Data From Other Sources

Description and Management of the Data. The daily consumptions of whole cow's milk (designated hereinafter as WCM), evaporated milk (designated as EV), ready-to-use or prepared formula (designated hereinafter as PF-X, where X is an abbreviation of the brand name), or human milk (designated hereinafter as HM) were stated in or could be calculated from other data in several balance studies (18, 22-25) and dietary surveys (26-33). These data are collected in Table 1. Table 1 also includes calcium intake in milk and total diet. Consumption of four categories of solid foods and total solid food intake are summarized in Table 3. Mineral intake in solid foods is summarized in Tables 4 through 7. Daily milk or formula volume--without regard to the identity or composition of the milk product--is plotted as a function of age in Figure 1. Figures 2 through 5 show, also as functions of age, experimentally determined or calculated total, milk, and solid food intakes of calcium, phosphorus, sodium, and potassium, respectively. The following paragraphs are detailed descriptions of the balance studies and dietary surveys that were used to estimate the average milk and mineral intakes of infants, and were included to enable the reader to make an independent judgment of the validity of the average intakes estimated in this paper.

Kahn et al. (18) 1969. Thirty subjects ranging in age from 30 to 300 days lived at home. Their food intake and excreta were monitored continuously for periods ranging from several weeks to 270 days. They drank EV, PF-S, or PF-E.* Solid foods were furnished by the investigators and were fed at the discretion of the mothers and the attending pediatricians. The following data were included in the paper: daily formula volume ± S. D. for all subjects as a group, total calcium and phosphorus, formula calcium and phosphorus, calcium and phosphorus in five categories of solid food, and bulk intake of solid foods. From these data and published concentrations, sodium and potassium intakes in formula and solid foods could be calculated. A ready-to-eat cereal and fruit mixture was fed to these subjects. The authors estimated that an additional 80 ml/day of formula would have been taken if common practice of mixing dry baby cereal with formula had been followed. Formula volumes shown in Table 1 and Figure 1 have been corrected by adding 80 ml to the stated daily intakes, and S. D.'s were scaled up proportionately.

*PF-S, Similac, Ross Laboratories, Columbus, Ohio; PF-E, Enfamil, Mead-Johnson Laboratories, Evansville, Indiana.

However, mineral intakes shown in the rest of the Tables and Figures are the authors' experimental values.

Nelson (22) 1931. Nine male infants ranging in age from 55 to 330 days lived in an institution. Three-day balance trials were carried out repeatedly at irregular intervals. The subjects drank WCM with added corn syrup and lactic acid. No solid foods were given for the first 3 months. Only small amounts of egg yolk, fruit, and vegetables were given for the rest of the first year. The ages and total calcium and phosphorus intakes were tabulated in the paper for each subject. The raw data were grouped by age and average intakes ±S. D. were calculated by us. Intake of calcium and phosphorus in solid food was considered negligible, and milk volumes were calculated by using published mineral concentrations in WCM.

Duckworth and Warnock (23) 1942. This paper is a review of early balance studies including Nelson's (22). All the subjects were institutionalized. They drank HM, EV, or WCM. Carbohydrate and small amounts of various acids were frequently added to the cow's milk products. Average total calcium intakes were tabulated for each age group in each experiment. Individual experiments in which the same form of milk was fed were combined by us and grand averages ±S. D. were calculated (weighted for the number of case-days in the individual studies). Neither milk calcium nor milk volume could be calculated because of the lack of information about solid food.

Fomon and May (24) 1958. Nine infants of both sexes ranging in age from 4 to 180 days were hospitalized during three-day balance periods and lived at home at other times. They drank pasteurized pooled

HM and received no solid food. Body weight and daily milk consumption tabulated for the individual subjects in ml per kilo body weight were converted by us to daily milk volume/infant. These were then grouped by age, and average daily milk volume ±S. D. and average daily total calcium, phosphorus, sodium, and potassium ±S. D.'s were calculated.

Fomon *et al.* (25) 1963. As before, the subjects were hospitalized during the three-day balance periods and lived at home at other times. They drank PF-S, PF-S-26, or PF-22-3* and were given no solid food. [The subjects drinking HM discussed in this paper are the same subjects described in an earlier paper (24).] Body weights and total daily intakes of calcium and phosphorus per kilo body weight were tabulated for each subject, including those that drank HM. Total calcium and phosphorus intakes were calculated by us — these were grouped by age, and mean intakes ±S. D. were calculated for the various milks. Formulas and HM were the sole food sources, therefore, daily milk volumes could be calculated from total calcium intakes and calcium and phosphorus concentrations of the milks furnished by the authors.

Beal (26) 1954. The subjects were 58 "upper middle class" urban children. Milk or formula volumes and solid food intakes were recorded for one day each month (beginning in 1946) through the first 6 months and quarterly to five years of age. The infants were fed solid foods at the discretion of the mothers on the advice of their prediatricians. No attempt was made by the investigator to influence formula or solid food

*PF-22-3, Ross Laboratories; PF-S-26, Wyeth Laboratories, Philadelphia, Pennsylvania.

intake. Children who were breast-fed or receiving PF were excluded. Median total intakes of calcium and phosphorus were tabulated. Daily total calcium, milk calcium, and milk volume were shown graphically. Total average milk calcium and phosphorus were calculated by us from milk volumes and published mineral concentrations for WCM and EV (assuming 1:1 dilution, inasmuch as the author made no mention of dilution). Total solid food calcium and phosphorus were calculated as the difference between total and milk mineral; S. D.'s could not be calculated.

Guthrie (28) 1963. Daily milk and food consumption were recorded for seven consecutive days for a group of 52 "upper middle class" suburban children ranging in age from 9 months to 2 years. By the ninth month all the subjects were drinking WCM. The subjects were all under the care of a single pediatrician, and their mothers presumably received uniform dietary guidance. Solid foods were fed at the discretion of the mothers, and as in the Beal study (26), no attempt was made by the author to influence food intake. Average total calcium intakes were given for several age groups. Solid food was estimated from Figure 2 of this paper for each age group, and milk calcium was estimated as the difference between total calcium and calculated solid food calcium. Milk volume was estimated in turn from milk calcium and the published concentration of calcium in WCM. These estimated values, although included in Table 1 and Figures 1 and 2, are shown for comparison only and were not used further.

Bransby and Fothergill (27) 1954. This survey was conducted in the United Kingdom at a time when World War II food rationing was still in force. The sample, which was designed to be representative of the U. K. infant population, consisted of 750 children 6 to 48 months old. Breast-fed children were excluded, and PF were presumably not marketed in the U. K. at that time. Milk and food intakes were measured and recorded by the mothers for seven consecutive days. Total calcium was tabulated for each age group. A significant fraction of milk consumed by children more than 1 year old was included in prepared foods rather than being drunk as liquid milk. Milk calcium and milk volume were estimated from stated total calcium and the author's estimate of the fraction of calcium contributed by the solid foods themselves. As in the case of the Guthrie data (28), although shown in the Tables and Figures, estimated values were not used further. These data were included to provide a comparison between contemporary U. S. and U. K. infant feeding practices.

Filer and Martinez (29, 30) 1963, 1964; Cox (20) 1967; Martinez (31) 1969. Data on file with the National Birth Records Company, New York, which records about 85% of all U. S. births, were used twice a year to construct samples consisting of approximately 6,000 representative 6-month-old U. S. infants. The published results for 1962 (29) and 1963 (30) agreed well with U. S. Census data with respect to region, rural or urban residence, age and education of the mother, and family income. Low income and (or) rural families and residents of the Appalachian and Southern geographic regions were somewhat underrepresented in their samples, but it seems highly likely that births in low-income rural families are a significant fraction of the 15% of U. S. births not recorded by the NBRC.

The sampling device was a mailed questionnaire. Failure to reply was followed by two more mailings. A total response of 77% was obtained. Lower than average response by less well educated rural mothers may also have contributed to the under-representation of infants in these segments of the population in the total sample. The published portion of the questionnaire (29) asked the mother to record what her baby ate during one day: "How many ounces of milk (or formula) did your baby drink yesterday?" A list of solid foods followed, and space was provided to record amounts in teaspoons.* The remainder of the questionnaire, which was not published (31), asked for information on the kind of milk product the baby was drinking. Half of the respondents in each annual sample were also asked to recall the kind of milk product fed and how much was fed in one day at ages 1 week and 1, 2, 3, and 4 months. Independent checks were made of the reliability of the milk volumes obtained by this retrospective method, and one of the authors (31) concluded that the volumes, although perhaps a little high, are close to reality. Intakes of milk and solid foods were tabulated in the published papers either as total calories per item or as the fraction of total calories contributed by each item. A table of conversion factors was included which permitted these data to be converted to volume or grams weight, which in turn permitted calculation of the mineral contributions

*This survey technique has produced reproducible average milk and solid food intake values for the 6-month-old. The range, S.D., and percentile distributions have also proved to be reproducible (31).

of individual food categories. The average daily calcium and phosphorus intakes calculated by the authors assumed that all the infants were drinking WCM. We have chosen to recalculate mineral intakes using Cox's data (20) on the frequency of feeding milks of varying mineral content. S. D.'s were scaled down accordingly.

Bureau of Census (33) 1963. The National Food Consumption Survey of mid-1962 included 1460 infants less than 1 year old and 5963 children 1 to 4 years old. The samples were representative of the U.S. population of infants of the respective age groups as to region and kind of residence and family economic status. The tabulation included the average daily consumption by infants drinking only liquid WCM.

Rivera (32) 1968. The subjects were 16 upper-middle-class urban infants, all children of employees of the U.S. AEC Health and Safety Laboratory, New York, ranging in age from 1.5 to 11.5 months. A duplicate of a single 24-hour food and milk intake was analyzed for calcium, strontium, and ^{90}Sr. The milk products and solid food items were not identified.

RESULTS AND DISCUSSION

Milk Intake--The Influence of Body Size, Growth, and Solid Food. Milk is the chief source of all nutrients in the infant diet. Therefore milk composition and the volume drunk together determine individual variations of mineral intake. All of the milks that are now commonly fed to infants have about the same energy content [in kCal/100 ml (of a 1:1 dilution where appropriate)] : HM, 75; WCM, 69; EV, 69; PF, 64 to 67 (19). The protein concentration of cow's milk products is more than twice that of HM [in g/100 ml (of a 1:1 dilution where appropriate)] :

HM, 1.1; WCM, 3.3; EV, 3.8; PF, 1.5 to 3.4, with a mean of 2.0 (19). However, when infants are drinking the same volume of milk (HM, WCM) or formula (PF, EV) and are taking the same amount of protein and calories, their mineral intakes can vary in the ratio HM:PF:EV :: 2:4:7 (19).

The amount of milk drunk each day is influenced in the long run by caloric needs for energy and growth and on a day-to-day basis by the feelings of well being and satiety. A tired sick infant will take less milk at a feeding than a rested healthy infant. The feeling of satiety is brought about by the fullness of the stomach and the rate of stomach emptying.

It has been commonly observed that male infants drink more milk than female infants. Although the birth weights of male and female infants are nearly the same, male infants grow faster in early infancy, and the studies by Fomon et al. (25) clearly demonstrate that the greater milk intake of the male infants is a function of their larger body size. The intakes of HM or PF by the girls and boys in their experiments are summarized in Table 2. The girl's daily milk intakes were, on the average, 40 to 150 ml less than the intakes of the boys during the age span from 15 to 210 days. The small sample sizes and great individual variability among infants of the same sex rendered these small differences statistically insignificant until 130 days of age, at which time the average body weight of the boys was 0.83 kg more than the average body weight of the girls.

Except in the case of prolonged feeding of a formula that is too dilute, and therefore not calorically satisfying, formula and milk composition (i.e., casein vs. whey proteins, butter fat vs. vegetable fats or the unsaturated fats of HM, and lactose vs. sucrose) seem to have only a minor influence on the volume of milk consumed (22). Infants take less milk when gastrointestinal passage time is slow, because they are hungry less often (19). The smaller volume of WCM drunk by the boys in Nelson's study (22) (see Table 2) compared with that consumed by the boys drinking HM and PF in the studies by Fomon et al. (25) conflicts with the observations that gastrointestinal passage time of fresh HM is longer than that of WCM (19). However, the differences between the milk volumes drunk by boys in the two studies may have been influenced by different experimental methods. The boys in Fomon's studies (25) drank all the milk they would take, but the maximum milk intakes of the boys in Nelson's study (22) were predetermined by the nurses who fed them.

The general trend toward greater milk intake with increasing body size is apparent through the first 6 months of age only in those groups of infants that were not taking any solid foods (22, 24, 25). In our study and that of Kahn et al. (18) total caloric intake rose steadily from about 525 kCal/day at 1 mo to 941 kCal/day at 16 mo, and the increase was due almost entirely to the increasing bulk of solid foods eaten.

The common practice is to offer solid foods before milk, and an infant receiving solid foods is therefore taking milk into an already partially filled stomach. In addition, the rate of stomach emptying is slowed by the presence of solid food. Without reducing energy or protein intake, solid foods in the infant diet can reduce milk volume, and consequently, reduce mineral intake, especially calcium intake, by partially filling the stomach and slowing gastric emptying. The depression of milk consumption by solid foods is shown in Table 2 and Figure 1. In our studies two of the five boys received very little solid food before the third month. The average milk intake of our boys was lower than the intake of Fomon's boys (25), but only significantly lower ($P < 0.01$) after 90 days when all our boys were taking solid foods. Two of the five girls in our studies were given large amounts of infant cereal from ages 2 and 3 weeks. The average milk intakes of our girls (but not of Fomon's girls (24, 25) who were eating no solids) were significantly different from the intakes of Fomon's boys after 30 days, and also significantly different from the intakes of Fomon's girls after 90 days.

Examination of Table 1 and Figure 1 reveals that the high-milk-consuming groups were those that received little or no solid food (22-25) and the low-milk-consuming groups were those that received substantial amounts of solid foods (this paper, 18, 26-28). The practice of feeding solid foods to very young infants was documented for "upper middle class" urban children in the Beal survey (26), which was begun in 1946. By 1953 the early feeding of solids was considered sufficiently important to warrant a special study by the editors of a pediatric journal (39). In the latter report several leading pediatricians commented on the possible reduction of milk intake when substantial amounts of solid foods were given. More recent reports indicate that the introduction of solid foods into the diet of the 4- to 6-week-old infant is now a common practice at all economic levels in the urban United States (21), but is perhaps less frequent among the rural U. S. population (29, 30) and in the United Kingdom. During the period of interest of this review--1954 onward--addition of some solid food after the first month of life appears to be the general rule.

Estimation of Average Daily Milk Intake. The average daily intakes by the experimental balance study groups and by the infant population samples in the dietary surveys are plotted as a function of age in Figure 1. The solid line in the figure is our best approximation of the average milk intake of U. S. infants, and was fitted to the dietary survey data of Martinez (31) and Filer and Martinez (29, 30) from birth through 6 months and to the average of the balance studies (this paper ref. 18) and dietary surveys (26-28) from 6 to 24 months. Milk intake increases rapidly from about 350 ml/day at birth to between 700 and 800 ml/day by the third week. It continues to rise (but less rapidly), so that by the end of the second month a maximum of about 840 ml/day has been reached. This intake level is maintained through about the sixth month, at which time nearly all infants are receiving some solid food, and a large fraction of both breast- and bottle-fed infants are being weaned to a cup. Both of these factors plus a slowing of the growth rate tend to reduce the average milk intake, and milk volume declines to about 670 ml/day by the tenth month. A slower but continuous decline ensues for the next 14 months, so that the milk intake of the 2-year old is about 530 ml/day (1.1 pint).

The average intake curve based largely on dietary survey data agrees with most of the experimental points during the first 20 days of life. It coincides with the milk intake curve (dotted line) of subjects taking no solid foods through the second month. It lies midway between the "no solid food" and "solid food" curves from the second through the sixth month. It would appear that most of the U. S. infant population receives only a little solid food during the first 2 months, and that the quantity of solid foods given through the sixth month is no more than one-half the amount fed in our balance study or that of Kahn et al. (18) or to the infants included in Beal's survey (26).

Fluctuation in Milk Intake. The S. D.'s of the average daily milk intakes of the balance study groups--boys and girls combined--were usually 10 to 20%, but the S. D.'s of the mean intakes obtained in the Filer and Martinez (29, 30) surveys were 37%. Milk intake was recorded and averaged over 3 or more days in the balance studies, but these survey data represented only one-day intakes. Analysis of variance (40) was used to assess the separate contributions to the total variance, $(S.D._T)^2$ [equivalent to the $(S.D.)^2$ determined by Filer and Martinez (29, 30)] of (a) daily fluctuations in the intakes of individual infants [within-sample variance, $(S.D._W)^2$] and (b) the fluctuations due to different dietary patterns of the infants in each sample [between-sample variance, $(S.D._B)^2$].

The daily within-child variation in our EV and PF-MO subjects contributed somewhat more than half of the total variance before 60 days of age--the age at which solid foods are fed in small amounts, and then only to some infants, and the body sizes of boys and girls are still not too dissimilar. After 60 days the greater diversity of dietary patterns and the larger differences in the body sizes of boys and girls led to an increase in the between-child variation, so that after 60 days the within-child variance and the between-child variance were roughly equal.

$(S.D._T)^2 = (S.D._W)^2 + (S.D._B)^2$. After 60 days of age $(S.D._W)^2 = (S.D._B)^2$ so that at 6 months,

$(S.D._T)^2 = 2(S.D._W)^2 = 2(S.D._B)^2$. Inserting the $S.D._T$ obtained by Filer and Martinez (29, 30), $S.D._T = 289$ ml,

$(S.D._B) = [(2.89 \times 10^2)^2/2]^{1/2} = 204$ ml.

The calculated between-child variation in this large heterogeneous sample was 25% of daily intake, and, as might be expected, is somewhat larger than the S. D.$_B$ of the more homogeneous experimental groups. The S. D.$_B$ of average milk intake is probably closer to 10 to 15% of daily intake during the first 3 months of life and increases to 20 to 25% by the sixth to eighth month. A retrospective survey by Neumann (41) of the total fluid intake of 312 preschool children in suburban Long Island, New York, suggests that the S. D.$_B$ of milk intake is close to 25% through the sixth year.

The percentile distributions of milk intake reported by Martinez (31) for 6-month-old infants were not symmetrical, but were skewed towards high values. A typical distribution is as follows: daily intake less than 148 ml, 0.5%; 149 to 443 ml, 5.9%; 444 to 738 ml, 41.7%; 739 to 1034 ml, 38.1%; 1035 to 1329 ml, 8.7%; and more than 1329 ml, 5.1%. The median of 750 ml was less than the arithmetic mean, suggesting that the most probable daily intake of the 6-month-old may be nearly 100 ml less than the average daily intake of 840 ml (29, 30). Infants who consume large quantities of milk (more than 1 S. D. above average) also have an elevated ^{90}Sr intake and are therefore of special concern. It would appear that about 15% of 6-month-old U. S. infants drink more than 1000 ml/day of milk. In our balance studies the largest fraction of daily intakes exceeding 1000 ml/day was 5.4%, and occurred during the interval between 30 and 60 days while solid food consumption was still low. Boys accounted for 33 of the 39 days (out of a total of 1343 child-days) on which milk intake exceeded 1000 ml. In the studies by Fomon et al. (25) milk consumption greater than 1000 ml/day was twice as frequent among boys as among girls. The frequency of high milk intakes among that group of infants (who were receiving no solid foods) was as follows: 30 to 90 days, 19%; 90 to 160 days, 32%; and 160 to 180 days, 39%. Inasmuch as the average milk intake approaches a maximum at 6 months of age, and most infants receive some solid foods after the second month, it seems reasonable to assume that the frequency of drinking more than 1000 ml/day of milk is not greater than (and may well be less than) 15% among both younger and older infants.

Intake of Minerals in Solid Food. The lack of information about solid food intake is not surprising. There are so many varieties; retrospective estimates are imprecise; and actual measurements are either clumsy or tend to influence the results. Bulk solid food consumption is of interest *per se*, because of its influence on milk consumption. The amount of each different kind of solid food must also be known before mineral intake can be calculated, because of the variable composition of solid foods. The single point at 6 months of age (29, 30) is the only available information about the solid food intake of average U. S. infants at any age. The intake of 6-month-old infants determined in that survey was nearly the same as the solid food intakes of the balance study subjects (this paper, ref. (18))and of the subjects studied by Beal (26). From 6 to 24 months of age the milk intakes in both the balance studies and all the dietary surveys were the same, suggesting that bulk solid food consumption was also similar. The average milk intake of the general population of infants less than 6 months old was about midway between that of balance study subjects taking solid food and balance study subjects taking no solid food, suggesting that the average bulk solid food intake of the average infant in the general population is greater than zero, but less than that fed in the major balance studies or the Beal survey (26).

The average bulk solid food intake shown in Table 3 and the average intakes of minerals in several categories of solid foods (see Tables 4 through 7) were estimated as follows: (a) From birth to 5 months, average solid food consumption was assumed to be one-half that taken by the infants in the balance studies conducted by us and by Kahn et al. (18) and the subjects in Beal's (26) survey; the 6-month point was considered to have been defined by the Filer and Martinez (29, 30) survey; and (c) from 7 to 24 months average solid food consumption was assumed to be equal to the average measured intakes of the balance studies (this paper, ref. 18) and the recorded intakes of the other dietary surveys (26-33).

Calcium. (See Table 4 and Figure 2.) During the first 10 months baby cereals, especially fortified with calcium phosphate, are the only significant solid food source of calcium. During the second year as larger amounts of eggs, vegetables, and fortified breakfast foods are fed, solid food calcium increases to about 200 mg/day.

Phosphorus. (See Table 5 and Figure 3.) Although larger amounts of phosphorus are present in a greater variety of solid foods, fortified dry infant cereals are the main solid food phosphorus source during the first 6 months. Phosphorus-rich meat and eggs added to the diet after the sixth month gradually replace infant cereal as the main solid food phosphorus source. Phosphorus intake in solid foods rises from 200 mg/day at 6 months to nearly 400 mg/day at the end of the second year. It should be noted that by 4 months the breast-fed infant is probably deriving more than 50% of his phosphorus intake from solid foods.

Sodium. (See Table 6 and Figure 4.) During the early months of infancy when milk--especially HM or PF--is the sole or major food, sodium intake is low. Infant cereals and strained fruits contain little sodium. However, table salt is added by the processors to strained vegetables, meats, and meat and vegetable combinations (37). The addition of these foods to the diet at about the forth month raises the sodium intake to about 800 mg/day by the sixth month, and half the sodium is contributed by solid foods. Sodium intake rises rapidly as more solid food is ingested, so that by the end of the second year the average daily intake is about 1.25 g, of which 700 mg is derived from solid foods. Average body weights of infants are 6 to 7 kg at 6 months and 12 kg at 2 years, therefore, sodium intakes are 120 mg/kg at 6 months and 100 mg/kg at 2 years. In the United States the customary daily sodium intake of adults is estimated to be 3 to 7 g (42), or for a 70 kg man, 50 to 100 mg/kg/day. As Puyau and Hampton (43) pointed out, the sodium intake of the 6- to 12-month-old infant, per unit body mass, is near the upper end of the normal adult range as a result of the addition of table salt to baby foods.

Potassium. (See Table 7 and Figure 5.) A potassium intake of 0.8 to 1.3 g/day (11.5 to 18.5 mg/kg/day) has been estimated to be near the minimum adult daily requirement (44). Potassium is needed for growth as well as maintenance, but the quantity needed has not been established (44). Milk and most solid foods, except perhaps baby cereals, are good potassium sources. Doubling the upper level of the estimated adult requirement infers a requirement of at least 240 mg/day by the 6-month-old and 440 mg/day by the 2-year-old. The infant diets reported here provided a fivefold excess over this estimate of minimum potassium requirement for the 6-month-old and a fourfold excess for the 2-year-old.

Mineral Intake in Milk. During the 30 years between the introduction of EV in the 1920's and the marketing of PF in the early 1950's nearly all young infants were either breast-fed of bottle-fed with a formula made of diluted EV and carbohydrate. Mineral intake from HM is low (see Figures 2 through 5). Mineral intake from EV varies from a low close to that of PF [at the dilution of 2:1::water:EV recommended for the newborn (45)] to a high equal to that of WCM (at a dilution of 1:1). The earlier literature also suggests that breast feeding was often continued for many months and that EV formulas were frequently fed for the entire first year, because of their lower cost and greater bacteriological safety than local dairy milk. The increasing availability and bacteriological safety of local fresh milk in the 1940's along with more efficient refrigeration and distribution prompted larger numbers of mothers to shift infants to WCM at earlier ages. In the Neuman (41) and Guthrie (28) studies (published in 1957 and 1964, respectively) nearly all the subjects (middle-class urban or suburban) were drinking WCM after 6 months of age. Unfortunately, these studies contained little information about the ages at which that shift had been made.

The introduction of low-mineral PF further complicated the picture. In the absence of information about actual infant feeding practices, Klein (10) estimated infant calcium intake by assuming that all infants drank PF for the first 3 months and EV for the next 9 months of the first year. No attempt was made to account for frequency of breastfeeding, or the fact that a switch from PF to EV is extremely rare (31), or the rate of change to WCM.

The Kinds of Milk Fed to Infants Since 1953. (See Table 8 and Figures 6 and 7.) The market surveys by Cox (20), Filer and Martinez (29, 30), and Martinez (31), all of the Ross Laboratories, processors of one brand of PF, supply much of the heretofore missing information on the month-by-month frequencies of the feeding of various milks during the first year of life. Their published data include (a) complete information on month-by-month milk use through 4 months of age for the year 1958 and through 6 months of age for the year 1965 (20); (b) trends in feeding various milks to 1- and 4-month-old infants during the 8-year span from 1958 through 1965 (20); (c) frequency of feeding EV and PF to 10-day- and 1-month-old infants in the years 1966 through 1968 (31); and (d) observations by Martinez (31) that the frequencies of HM and WCM feeding at each month (through the sixth month) were nearly constant from 1958 onwards, and that after the sixth month the rate at which infants are shifted from the breast and formulas to WCM has not changed since 1958. The above described data appear in Table 8 in boldface type. Missing values for the years 1953 through 1968 were estimated as described below and appear in Table 8 in ordinary type.

(a) The fraction of infants drinking each kind of milk in the years 1958 and 1965 was read from Cox's curves (20) and replotted. The feeding trends after 4 to 6 months of age were estimated for these two years by extrapolating the best eye-fit straight lines drawn through the last two or more points on the HM, EV, and PF curves. The terminal trend of the WCM curve could not be determined by extrapolation, but because the sum of the fraction of infants drinking the four milks could not exceed 1.0, the WCM values could be calculated by difference,

$$WCM = [\ 1.0 - (HM + EV + PF)]\ .$$

The data and the extrapolated curves are shown in Figure 6 for the year 1965.

(b) Published data (20) were available only for 1- and 4-month-old infants in the intervening years, 1959 to 1964. The fractions of infants drinking various milks at 10 days and 2, 3, 5, and 6+ months were estimated for these years by analogy and interpolation. The 1- and 4-month data were plotted for each milk variety for each year. These plots were superimposed on the complete curve of the appropriate milk category for the year 1958 or 1965 (whichever was closer on the time scale), shifted along the ordinate until both points coincided with the curve beneath, and a new curve was traced.

For the years 1960 and 1962, midway between the years for which trends were well defined, the 1- and 4-month points of EV and PF consumption could not both be aligned with either the 1958 or the 1965 curve, but could be fitted to synthetic curves drawn halfway between the curves for these two years.

(c) Missing values for the years 1966 through 1968 were estimated by superimposing plots of the 10-day and 1-month data for these years on the 1965 curves.

(d) The fraction of infants fed different kinds of milk during the years 1953 through 1957 were also of interest, because detectable amounts of radioactivity were entering the general environment as early as 1953-54. Distribution of the kinds of milk drunk after 6 months of age was assumed to be the same as in 1958.

(e) The fraction of 1- and 4-month-old infants drinking each category of milk (20) was plotted vs. calendar year for the years 1958 through 1968. The trends in feeding the four kinds of milk to infants 1 month of age is shown in Figure 7. The long-term trends of the fraction of infants drinking HM and WCM were almost linear during the entire period. The tendency mothers to feed PF to their 1-month-old infants in preference to EV accelerated in about 1961, and, therefore, only the points from 1958 to 1962 were included in the back extrapolations of the EV and PF trends. Increase in the use of PF has been almost all at the expense of EV, thus uncertainties in the placement of the extrapolated curves could be checked by assuming that the sum EV + PF was always 0.69. The extrapolated PF curve reaches zero in the year 1949. We did not attempt to determine the year in which each PF brand was first marketed, but a scan of advertisements in those pediatric, general medical, and dietetic journals that accept advertising suggested the first brands of PF were being advertised by 1950.

(f) The extrapolated values for 1- and 4-month-old infants were plotted separately for each milk variety by year, and these plots were superimposed on the 1958 curve as described in (b) above to yield estimates of the fraction of infants drinking various milks at other ages.

Average Daily Mineral Intake of Infants. Between 1950 and 1958 there was a major shift in the kind of milk product most commonly fed to infants under 6 months of age. In 1950 about 70% of infants were being fed EV formula at 1 month; in 1968 about 70% of infants were being fed PF at the same age. However, the total mineral intake in milk at any age during the first 6 months did not change much, because the 2:1::water:EV dilution recommended for the newborn infant provides the same amounts of most minerals as an equal volume of 1:1 dilution of most brands of PF. Assuming that both EV and PF were diluted according to processor's and pediatrician's instructions (13, 45), the average mineral concentration, C_t, of the milk fed to infants can be calculated month by month,

$$C_t = \text{mg per 100 ml of } M^{+n} = \sum (fr_{it} \times C_i) , \quad (1)$$

where M^{+n} is the mineral under consideration C_t is the average concentration of M^{+n} in milk fed at age t; fr_{it} is the fraction of infants drinking milk product i at age t; and C_i is the concentration of M^{+n} in milk product i. The calculated monthly average concentrations, hereinafter referred to as average concentrations, of calcium, phosphorus, sodium, and potassium of milk fed to infants are shown in Table 9.

The average daily mineral intake in milk, I_t, can be calculated,

$$I_t = \text{mg/day of } M^{+n} = (C_t \times V_t) , \quad (2)$$

where I_t is the daily intake of M^{+n} at age t; C_t is the average mineral concentration calculated at age t using Eq. 1; and V_t is the average daily milk volume drunk at age t read from Figure 1. The calculated average daily intakes, hereinafter referred to as average daily intakes, of calcium, phosphorus, sodium, and potassium are shown in Table 9 for infants from 10 days to 2 years of age.

The average daily intakes of calcium, phosphorus, sodium, and potassium in milk are plotted as functions of age in Figures 2 through 5, respectively. The average daily intakes of these four minerals in solid foods were read from Tables 4 through 7 and also plotted in the appropriate Figures. The curves labeled "total mineral" are the sums of the average daily intakes in milk and solid foods of each of the four minerals.

During the first 4 to 6 months the average total daily intakes of calcium, phosphorus, and potassium fell well above the measured total intakes of the balance study subjects drinking low-mineral milks (HM, PF, or dilute EV) but somewhat below the measured total intakes of the balance study and survey subjects who drank high-mineral milk (WCM or 1:1 diluted EV) and took little or no solid food. After the first month the total daily sodium curve lay close to the measured intakes of balance study and survey subjects drinking high mineral milks because of the large sodium contribution of some solid infant foods. After 4 to 6 months of age, when most infants have been changed from breast and formulas to WCM, and when a larger fraction is receiving substantial amounts of solid foods, the average total calcium and phosphorus intake curves agreed well with the measured total intakes reported in dietary surveys (26-33). Sodium and potassium intakes could not be calculated from any survey data other than the Filer and Martinez (29, 30) studies of 6-month-old infants, and the extent of agreement between the calculated average daily intakes of these elements and actual infant diets is uncertain. However, had the subjects in our PF-MO balance study been drinking WCM after 6 months of age, as most infants are at that age, their sodium and potassium intakes would have been the same as or only a little greater than the average curves predict.

Total Calcium Intake During the First Two Years of Life. Total intake month by month is one of the parameters needed for solution of metabolic models of calcium utilization in the infant.

^{90}Sr analyses of foods and milks are reported almost universally relative to calcium content, that is, pC_i per g Ca, rather than per unit of mass or volume. Calculation of ^{90}Sr intake requires not only knowledge of total calcium intake, but because the concentrations of ^{90}Sr in solid foods and milks vary both with time and location of the raw material sources, detailed knowledge is also required of the amounts ingested in each individual food item. Precise evaluation of ^{90}Sr intake by the infant is complicated by rapid changes occurring (a) in the amount of calcium ingested; (b) in the dietary sources of calcium and ^{90}Sr; (c) in the ^{90}Sr content of milks (due to the annual rainfall cycle even in the absence of continued injection of fission products into the environment); (d) and in the infant himself--his skeleton and the physiology of his gastrointestinal tract.

Total calcium intake of the average U. S. infant was evaluated for a cohort of infants born 1 Jan. 1965 as,

$$\left[Ca_i\right]_{t_1}^{t_2} (mg) = C_i/2 \times \left|fr_{it_2} - fr_{it_1}\right| \times \int_{t_i}^{t_2} V_t dt , \qquad (3)$$

$$\left[Ca_T\right]_{t_1}^{t_2} (mg) = \sum \left[Ca_i\right]_{t_1}^{t_2} , \qquad (4)$$

where $\left[Ca_i\right]_{t_1}^{t_2}$ is the total calcium ingested in milk product i from ages t_1 to t_2; C_i is the calcium concentration of milk product i;

fr_{it} is the fraction of infants drinking milk product i at age t; V_t is the average daily volume of milk drunk at age t; and $\left[Ca_T\right]_{t_1}^{t_2}$ is the total calcium intake from all milks between the ages t_1 and t_2. C_i was read from Table 9; fr_{it} was read from Table 8; and solutions of the integral, $\int_{t_1}^{t_2} V_t dt$, for each month of age were evaluated numerically from the curve in Figure 1. Solid food calcium, Ca_s, was also evaluated numerically from the appropriate curve in Figure 2. The results are collected in Table 10.

According to the above calculations the average U. S. infant ingests 320 g of calcium in the first year of life--290 g from milk sources (90.6%) and 30.3 g (9.4%) from solid foods. Both milk and solid-food calcium intakes are well below the amounts estimated by Klein (10)--387 g of calcium from milks and 84 g from solid food. The average daily intake, estimated to be 877 mg calcium per day for the entire year, is only about 10% less than the value most recently proposed to the Federal Radiation Council (11). However, the FRC estimate of 20% of dietary calcium derived from solid food appears to be 100% too large.

Another of the parameters needed to test both calcium and ^{90}Sr metabolic models is the amount of calcium added to the skeleton each year. The most widely quoted value for calcium acquisition in the first year of life is 75 g (46). Although some authors consider balance studies unsuitable as a basis for calculation of changes in body content of specific minerals (25), calcium retention can at least be approximated from metabolic balance studies for comparison with measurements and estimates of body calcium content obtained independently. Examination of the results of the several balance studies collected in Table 11 indicates (a) that over a broad range of intakes--at least from 505 to 953 mg/day--the fraction of calcium retained is independent of intake and is on the average 28.2%, and (b) that the amount of calcium added to the infant skeleton is dependent on total calcium intake. Estimated total retention during the entire first year at the calcium intake (877 mg/day) calculated for the average U. S. infant is 90.2 g, about 20% greater than the value proposed by Mitchell et al. some 25 years ago (46), and 56% greater than the total retention calculated for balance study subjects who drank low-mineral PF for their entire first year (this paper and ref. 18). Variation in calcium accretion due solely to differences in the calcium concentration of milk would be expected to lead to a range from 48 g (for the entirely breast-fed child) to 105.4 g (for the infant fed WCM or EV 1:1 from birth).* Earlier it was shown that the $S.D._B$ of milk intake due to differences in appetite, body size, and solid food consumption was about 25%, which would cause the expected range of total skeletal calcium retentions to be still broader.

In the absence of actual measurements of skeletal mass and composition during the growth years the skeletal growth estimates

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*HM, [765 ml/day × 33 mg/100 ml + 83 mg (from solid foods)] × (0.393 × 365 days) = 48 g. WCM, [765 ml/day × 123 mg/100 ml + 83 mg (from solid foods)] × (0.282 × 365 days) = 105.4 g.

made by Mitchell et al.,* from which the first-year increment of 75 g calcium is derived, have gradually come to be regarded as quasi facts (3, 6, 7, 8, 11, 16, 48) rather than the rough approximation the authors intended. They pointed out that their calculations, which were based on many assumptions,* were "more an illustration of method rather than attainment of values". The dietary information in this paper strongly suggests that calcium accretion during the first year of life (and perhaps the second year also) of the modern U. S. infant may be 20% greater (28 g at birth + 90 g acquired = 118 g at 1 year) than the commonly assumed value of 100 g.

^{90}Sr Intake of Infants Born in New York City 1 January 1965. Since 1954 monthly samples of dairy milk purchased in New York City have been analyzed for calcium and ^{90}Sr; a current summary of results is available (49). Quarterly samplings of local dairy milk and of a standardized selection of solid foods have been made in San Francisco

*In their paper (Ref. 46) Mitchell et al. extrapolated growth data for boys 5 to 17 years at both ends to conform to a birth weight of 3.49 kilos and an adult weight of 67 kilos at 20 years. A fifth-degree polynomial was fitted to the extrapolated weight data. The changing calcium content of the boy's body was expressed by a forth-degree equation, based on the assumption (a) that the calcium content at birth is 0.8% and (b) that that in the adult is 1.6% and (c) that the change from infancy to adulthood occurs progressively throughout growth, but is more rapid when growth is more rapid.

and Chicago as well as in New York City since 1960 in a study called the Tri-City Diet Survey (50, 51). Strained baby foods and infant milks (EV and PF) were purchased quarterly in these three cities beginning in late 1959 in a study called the Infant Diet Survey (10, 32, 52, 53).

The ^{90}Sr ingested during each month through the first year of life and in the entire second year was calculated for a cohort of average U. S. infants born in the New York region on 1 January 1965 by use of (a) New York City ^{90}Sr analyses for the year 1965 (collected in Table 12); (b) the fractional calcium contributions of various milks to the infant diet for the same year (see Table 10); and (c) the calcium intake in solid food calculated in this paper (see Figure 2 and Table 10). The results are shown in Table 12. We calculate that this population of presumably typical infants would have ingested a total of 290 g calcium in milks [22 g in EV, 46 g in PF, 5 g in HM, and 216 g (74% of the total milk calcium) in WCM] and 30 g calcium in solid foods. The total ^{90}Sr intake was estimated to be 6650 pC_i [5820 pC_i in milks, of which 61% was contributed by WCM, and 830 pC_i (only 12% of total ^{90}Sr intake) in cereals and strained baby foods].

Earlier estimates of ^{90}Sr ingestion by infants suffered from acknowledged deficiencies of factual information. It is interesting to note, however, that our calculated calcium and ^{90}Sr intakes fall between calculated 1965 intakes based on the dietary assumptions of Klein (10) and Rivera (32)--473 g calcium and 9030 pC_i ^{90}Sr, and 260 g calcium and 5780 pC_i ^{90}Sr,* respectively.

The last two columns in Table 12 contain the monthly accumulated ^{90}Sr intakes (in milk) during the first 12 months of life and estimates of the $S.D._{Sr}$'s of these accumulated intakes.

$$(S.D._{Sr})^2 = (S.D._B)^2 + (S.D._{Mi})^2,$$

where $S.D._B$ is the same as previously defined and in this instance is taken to be 25%, and $S.D._{Mi}$ is the standard deviation in ^{90}Sr intake due to variations in the calcium and ^{90}Sr contents of various milks. The $S.D._{Mi}$'s were calculated by tracing from birth to 1 year the accumulated ^{90}Sr intakes of a synthetic population of 100 infants who were drinking the four milk varieties (WCM, EV, PF, HM) in the proportions reported for 1965 by Cox (20). The milk drinking history of each individual was entered in a table according to the following changes with age in the use of the different milk varieties (31): (a) switches from WCM to other milks are rare; (b) switches from EV to PF or vice versa are also rare (c) all except a few switches (during the first month from HM to PF) take place away from HM and formulas in the direction of WCM. ^{90}Sr intake in the volume of milk drunk by the average infant was calculated for each milk variety at each month of age (and calendar month), and the appropriate value was entered in the table for each infant in the population. Means and $S.D._{Mi}$'s of the accumulated ^{90}Sr intakes were

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*^{90}Sr intakes were not calculated by those authors for the year 1965, but rather, were calculated by us using their estimates of calcium intake in various milks and solid foods during the first year of life and the ^{90}Sr concentrations in these products in 1965 given in Table 12.

then calculated for each calendar month.

S. D.$_{Sr}$ is largest in proportion to the accumulated intake during the earliest months of life (S. D.$_{Sr}$ = 61% at 1 month and 34% at 12 months) chiefly because of the breat-fed infants whose ^{90}Sr intake is only one-tenth as great as that of infants drinking WCM or formulas (5). The variation in monthly ^{90}Sr intake because of milk variety (S. D.$_{Mi}$) disappears between the 6th and 9th months, when the whole infant population has switched to WCM, although variation in accumulated ^{90}Sr intake because of dietary history persists.

It is beyond the scope of this paper, and was not its purpose, to attempt a reconciliation between ^{90}Sr measurements of bone and ^{90}Sr burdens predicted from estimated calcium intakes, even though such a reconciliation is essential to the validation of the intake estimates. Preliminary calculations were made for 6-month-old and 1-year-old infants for the year 1965, however, and the ^{90}Sr burdens predicted from the calcium intakes estimated in this paper agreed reasonably well (within 25%) with published measurements of ^{90}Sr in bone for that year. The calculations assumed that OR was constant during the first year, and OR = 0.5 as measured through 10 months by Kahn et al. (18). The goodness of the agreement was hard to assess because there were only two New York City specimens each in the age ranges 1 month to 1 year and 1 to 2 years in that year, and their exact ages were not published. Samples of children's bones collected during one calendar year are published as averages for each 1-year age increment (55, 56).* This practice leads to inclusion of two annual cohorts in each 1-year age average, so that the sample designated "1 month to 1 year," for example, can represent infants born both at the beginning and at the end of the sampling year. The average age of the samples collected and reported in that manner is therefore at the midyear (0.5 year for the samples called "1 month to 1 year"); their average birth date is not at midyear, but at the beginning of the sampling year; and their diet is not that of the sampling year alone, but the average of the sampling year and the year before.

It is hoped that the age trends and chronological trends in infant feeding and the detailed estimates of calcium intake presented in this review will stimulate development of a data-processing system that will (a) permit use of all the monthly and quarterly diet and milk analyses rather than just annual averages; and (b) calculate cumulative ^{90}Sr intakes and predict ^{90}Sr burdens of cohorts of infants and children from the month of birth. The number of samples of young bone collected in any single calendar year in a single sampling region has been small--too small to provide adequate testing of currently accepted metabolic

*Information about individual specimens including age and month of death (from which birth date can be calculated) is available for samples collected before 1965 (55,57).

models--and obviously sample sizes are fixed for past years. However, even if only two samples of each 1-year age increment had been collected each year from only the three cities of the Tri-City Diet Study, the total collection over the last 10 years would now approach 1,000 specimens. There appears to be an alternative to the dilemma of being unable to make suitable tests of metabolic models because of small unreproducible samples, and that is the development of a computational system capable of predicting the ^{90}Sr burden of each annual cohort in every subsequent year from average diet information and intake estimates. Such a system would permit as many tests of the models as there are individual bone specimens.

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REFERENCES

1. J. L. KULP, W. R. ECKELMANN, and A. R. SCHULERT, Science 125, 219 (1957).
2. J. L. KULP and R. SLAKTER, Science 128, 85 (1958).
3. W. H. LANGHAM and E. C. ANDERSON, Science 126, 205 (1957).
4. W. R. ECKELMANN, J. L. KULP, and A. R. SCHULERT, Science 127, 266 (1958).
5. J. L. KULP, A. R. SCHULERT, and E. J. HODGES, Science 129, 1249 (1959).
6. J. L. KULP, A. R. SCHULERT, and E. J. HODGES, Science 132, 448 (1960).
7. J. L. KULP and A. R. SCHULERT, Science 136, 619 (1962).
8. FEDERAL RADIATION COUNCIL, Background Material for the Development of Radiation Protection Standards; Protective Action Guides for Strontium-89, Strontium-90, and Cesium-137, Federal Radiation Council Report No. 7 (May 1965).
9. G. W. DOLPHIN and I. S. EVE, Phys. Med. Biol. 8, 205 (1963).
10. S. KLEIN, Estimate of Strontium-90 in the Diet of New York City Infants Nurtured on Commercially Processed Baby Foods and Milk Purchased in August 1959 and January 1960, in Fallout Program Quarterly Summary Report, Health and Safety Laboratory, HASL-88, p. 231 (1960).
11. NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, Implications to Man of Irradiation by Internally Deposited Strontium-89, Strontium-90, and Cesium-137, Report of an Advisory Committee to the Federal Radiation Council, Federal Radiation Council, Washington, D. C. (Dec. 1964).

12. FOOD and NUTRITION BOARD, Recommended Dietary Allowances, National Academy of Sciences - National Research Council, Publication 589, 5th Rev. (1958).

13. B. SPOCK, The Common Sense Book of Baby and Child Care. Duell, Sloan, and Pearce, New York (1957).

14. C. L. COMAR, R. S. RUSSELL, and R. H. WASSERMAN, Science 126, 485 (1957).

15. H. SPENCER, M. LI, J. SAMACHSON, and D. LASZLO, Metabolism 9, 916 (1960).

16. F. J. BRYANT and J. F. LOUTIT, Proc. Roy. Soc. (London) 159B, 449 (1964).

17. S. A. LOUGH, J. RIVERA, and C. L. COMAR, Proc. Soc. Exptl. Biol. Med. 112, 631 (1963).

18. B. KAHN, C. P. STRAUB, N. C. TELLES, H. N. WELLMAN, R. A. SELTZER, and P. J. ROBBINS, Retention of radiostrontium, strontium, calcium, and phosphorus by infants, Pediatrics, in press.

19. S. J. FOMON, Infant Nutrition. W. B. Saunders Co., Philadelphia (1967).

20. D. O. COX, Ross Laboratories, Columbus, Ohio. Market research data quoted by Fomon (19).

21. R. P. EPPS and M. P. JOLLEY, Med. Ann. Dist. Columbia 32, 493 (1963).

22. M. V. K. NELSON, Am. J. Dis. Children 42, 1090 (1931).

23. J. DUCKWORTH and G. M. WARNOCK, Nutr. Abstracts Rev. 12, 167 (1942).

24. S. J. FOMON and C. D. MAY, Pediatrics 22, 101 (1958).

25. S. J. FOMON, G. M. OWEN, R. L. JENSEN, and L. N. THOMAS, Am. J. Clin. Nutr. 12, 346 (1963).

26. A. BEAL, Nutrition 53, 499 (1954).

27. E. R. BRANSBY and J. E. FOTHERGILL, Brit. J. Nutr. 8, 195 (1954).

28. H. A. GUTHRIE, J. Am. Diet. Assn. 43, 120 (1964).

29. L. J. FILER and G. A. MARTINEZ, Clin. Pediatrics 2, 470 (1963).

30. L. J. FILER and G. A. MARTINEZ, ibid 3, 633 (1964).

31. G. A. MARTINEZ, Ross Laboratories, Columbus, Ohio, Market Research Data for 1966 to 1968. Private communication.

32. J. RIVERA, Intake of ^{90}Sr, Sr, and Ca by Infants, Health and Safety Laboratory Report HASL-200, p. I-32 (1968).

33. BUREAU OF THE CENSUS, DEPARTMENT OF COMMERCE, and DIVISION OF RADIOLOGICAL HEALTH, PUBLIC HEALTH SERVICE, Consumption of selected food items in U. S. households, July 1962. Radiological Health Data 4, 124 (1963).

34. H. N. WELLMAN and B. KAHN, J. Pediatrics 72, 108 (1968).

35. M. L. WASHBURN and M. J. SHEAR, J. Biol. Chem. 99, 21 (1933).

36. GERBER PRODUCTS CO., PROFESSIONAL RELATIONS DEPT., Nutritive Values of Gerber Baby Foods. Gerber Products Co., Fremont, Michigan (1966).

37. GERBER PRODUCTS CO., Ingredients in Gerber Baby Foods. Gerber Products Co., Fremont, Michigan (1968).

38. B. K. WATT and A. L. MERRILL, Composition of Foods--Raw, Processed, Prepared, U. S. Dept. of Agriculture Handbook No. 8 (Rev. Dec. 1963).

39. A. M. BUTLER and I. J. WOLMAN, Quart. Rev. Pediatrics 9, 63 (1954).

40. N. J. MORONEY, Facts from Figures. Penguin Books, Harmondsworth, Middlesex (1951).

41. H. H. NEUMANN, Arch. Pediatrics 74, 456 (1957).

42. G. B. FORBES, Sodium, in Mineral Metabolism, Vol. II, The Elements, Part B (Edited by C. L. Comar and F. Bronner), p. 21. Academic Press, New York (1964).

43. F. A. PUYAU and L. P. HAMILTON, Am. J. Dis. Children 111, 370 (1966).

44. W. S. WILDE, Potassium, in Mineral Metabolism, Vol. II. The Elements, Part B (Edited by C. L. Comar and F. Bronner), p. 73. Academic Press, New York (1964).

45. J. VAN DOLAH, Formula Computer and Feeding Schedule. Carnation Co., Los Angeles, no date.

46. H. H. MITCHELL, T. S. HAMILTON, F. R. STEGGERDA, and H. W. BEAN, J. Biol. Chem. 158, 625 (1945).

47. E. M. WIDDOWSON and J. W. T. DICKERSON, Chemical Composition of the Body, in Mineral Metabolism, Vol. II, The Elements, Part A. (Edited by C. L. Comar and F. Bronner) p. 2. Academic Press, New York (1964).

48. H. L. FISHER and W. S. SNYDER, A computer code for estimation of body burden of ^{90}Sr based on observed ratio and bone remodeling which are age-dependent, in Oak Ridge National Laboratory Health Physics Division Annual Progress Report ORNL-3849, p. 188 (1965).

49. E. P. HARDY, JR., and J. RIVERA, Radiostrontium in milk and tap water, in Fallout Program Quarterly Summary Report, Health and Safety Laboratory, HASL-207, App. D-1 (April 1969).

50. J. RIVERA and J. H. HARLEY, Tri-City Diet Study, in HASL Contributions to the Study of Fallout in Food Chains, Health and Safety Laboratory Report HASL-147, p. 9 and 31 (1964).

51. E. P. HARDY, JR., and J. RIVERA, Tri-City Diet Study, in Fallout Program Quarterly Summary Reports, Health and Safety Laboratory, HASL-164, p. 214 (Oct. 1965); HASL-165, p. 218 (Jan. 1966); HASL-171, p. 221 (April 1966); HASL-172, p. II-19 (July 1966); HASL-173, p. II-19 (Oct. 1966); HASL-181, p. II-4 (April 1967); HASL-182, p. II-4 (July 1967).

52. J. RIVERA and J. H. HARLEY, Infant Diets, in HASL Contributions to the Study of Fallout in Food Chains, Health and Safety Laboratory Report HASL-147, p. 13 and 43 (1964).

53. J. RIVERA, ^{90}Sr, stable strontium, and calcium in the infant diet, in Fallout Program Quarterly Summary Report, Health and Safety Laboratory, HASL-173, p. I-58 (Oct. 1966).

54. S. A. LOUGH, G. H. HAMADA, and C. L. COMAR, Proc. Soc. Exptl. Biol. Med. **104**, 194 (1960).

55. J. RIVERA and J. H. HARLEY, The HASL Bone Program, 1961 - 1964, Health and Safety Laboratory Report HASL-163 (1965).

56. J. RIVERA, Strontium-90 in human vertebrae, in Fallout Program Quarterly Summary Reports, Health and Safety Laboratory, HASL-172, p. I-141 (July 1966); HASL-182, p. I-10 (July 1967); HASL-197, p. I-266 (July 1968).

57. J. L. KULP and A. R. SCHULERT, ^{90}Sr in Man and His Environment, Vol. II. Analytical Data, Geochemical Laboratory, Lamont Geological Observatory, Columbia University, U. S. AEC Report NYO-9934 (1961).

Table 1. Summary of selected studies of milk intake, milk calcium, and total calcium intake. Cow's milk (WCM or EV).

				Mean±S. D. or median		
Source	Kind of study	Case-days	Age (days)	Milk volume (ml/day ±S. D.)	Milk calcium (mg/day ±S. D.)	Total calcium (mg/day ±S. D.)
Duckworth and Warnock(23)	Balance	50	46- 61		↑	823±187
	No solids	286	76- 86			817±174
	WCM, EV	236	92-101		Same as	882±207
		585	137-160		total Ca	998±252
		126	168-191			1011±266
		156	203-211			1068±153
		117	252-295		↓	1158±161
Nelson(22)[a]	Balance	27	63- 87	756[b]	↑	920± 49
	No solids	57	91-108	826		1006± 67
	WCM	36	132-166	916	Same as	1122±148
		33	170-198	970	total Ca	1200±123
		18	203-230	1008		1227± 58
		24	242-278	1042		1269± 33
		21	284-324	1071	↓	1304± 38
Kahn *et al.* (18)	Balance	140	61- 90	728±132[c]	635	650
	Solid food	112	91-120	694±125	599	626
	EV	140	121-150	712±129	620	664
		196	151-180	690±114	626	678
		140	181-210	685±124	597	653
		252	211-240	680±116	585	648
		168	241-270	655±120	549	620
This paper	Balance	140	32- 61	778± 88	857±105	863±107
	Solid food	196	62- 89	742± 70	878± 84	911± 76
	EV	210	90-126	747±104	941±140	990±143

				Mean±S. D. or median		
Source	Kind of study	Case-days	Age (days)	Milk volume (ml/day ±S. D.)	Milk calcium (mg/day ±S. D.)	Total calcium (mg/day ±S. D.)
Beal(26)	Survey, U. S., Solid food, WCM, EV	27	0- 30	476	580[d]	580
		34	31- 60	660	803	810
		35	61- 90	710	864	910
		38	91-120	742	903	960
		37	121-150	769	936	1000
		38	151-180	790	961	1040
		40	181-270	718	874	1050
		41	271-360	639	777	1020
		42	361-450	585	712	970
		40	451-540	541	658	900
		36	630-720	488	594	770
Guthrie(28)	Survey, U. S., Solid food, WCM, EV	84	274-336	709[b]	863[d]	998
		84	365-488	630	767	964
		49	518-610	536	652	835
		63	640-732	581	707	944
Bransby and Fothergill(27)	Survey, U. K., Solid food, Milk not identified	644	180-360			970±220
		644	360			750±270
		644	720			720±230
Filer and Martinez(29-31)	Survey, U. S.,	2000	7	747		
		2000	30	791		
		2000	60	848		
		2000	90	865		
		2000	120	871		
	Solid food,	4310	183	828[e]	877[e]	998±334[e]
	Various milks	4146	207	812±289[e]	860[e]	974±338[e]
Bureau of The Census(33)	Survey, U. S. Solid food WCM	5963	365-1460	516	628[d]	
Rivera(32)	Duplicate meals	8	54-216			660±307
	Solid food milk not identified	8	250-347			744±299

Modified Cow's Milk Infant Formulas (PF)

Source	Kind of study	Case-days	Age (days)	Milk volume (ml/day ±S. D.)	Milk calcium (mg/day ±S. D.)	Total calcium (mg/day ±S. D.)
				Mean±S. D. or median		
Fomon et al. (25)	Balance	18	11- 30	710[b]	↑	524±115
	No solids	30	31- 61	844		625±127
	PF-S	21	62- 90	918	Same as	680±171
		45	91-126	945	total Ca	700± 93
		48	130-160	898		665±119
		39	161-182	1019	↓	755±144
Fomon et al. (25)	Balance	27	15- 30	779[b]	↑	325± 45
	No solids	39	31- 60	794	Same as	331± 54
	PF-S26	36	61- 90	897	total Ca	374± 66
	and 22-3	45	91-124	983	↓	410± 54
Kahn et al. (18)	Balance	252	31- 60	734±136	418	424
	Solid food	532	61- 90	↑	407	422
	PF-S	728	91-120	See	384	411
		700	121-150	Kahn et al. (18)	390	434
		700	151-180	entry above	382	434
		560	181-210		386	442
		560	211-240		393	456
		336	241-270	↓	390	461
		224	271-300	670±151	395	472
This paper	Balance	84	32- 61	684± 23	561± 51	593± 38
	Solid food	84	62- 89	725±133	598± 98	652± 31
	PF-MO	96	90-126	720±117	599±103	696± 6
		84	167-200	640±44	513± 40	641± 69
		56	201-238		529± 42	698± 92
		70	311-348	693±101	599±127	692±114
		70	349-379		555± 64	676± 30
		96	446-490	663± 76	447±104	572±153
		70	491-518		467± 97	568±182

Human Milk (HM)

Source	Kind of study	Case-days	Age, days	Milk volume (ml/day ±S. D.)	Milk calcium (mg/day ±S. D.)	Total calcium (mg/day ±S. D.)
				Mean±S. D. or median		
Fomon et al. (24, 25)	Balance No solids HM	30	11- 30	760±140	Same as total Ca	231± 43
		42	31- 60	900± 80		274± 24
		33	61- 90	890±100		270± 30
		42	91-120	955± 97		290± 29
		39	121-150	970± 79		295± 24
		36	151-180	1016± 59		309± 18
Duckworth and Warnock(23)	Balance No solids HM	31	46- 61	736[b]	Same as total Ca	242±145
		19	72 - 86	1006		331±137

Footnotes:

a. Included in Duckworth and Warnock totals (23).

b. Underlined milk volume entries were estimated as follows: When no solids were fed, milk volume was calculated from (Ca intake) × (mg Ca/100 ml milk); WCM, 121.7 mg Ca/100 ml (19, 35, 36); PF-S, 73.8 mg Ca/100 ml (25); PF-22-3 and S-26, 41.7 mg Ca/100 ml (25); and HM, 32.9 mg Ca/100 ml (25). When solids were fed, but neither solid food Ca nor milk Ca was stated, solid food Ca was read from Fig. 2 for the appropriate ages, and milk Ca and milk volume estimated.

c. Kahn et al. (18) fed a ready-to-eat cereal. A correction of 80 ml of formula was added to their raw formula volumes and the S. D.'s were scaled upward accordingly.

d. Underlined milk Ca entries were calculated for the Beal subjects, (26) none of whom drank PF or HM as (stated milk volume) × (123 mg Ca/100 ml of WCM; for the Guthrie subjects, (28) none of whom drank PF or HM, as (total Ca) - (solid food Ca from Fig. 2); for the Bureau of Census subjects (33), all of whom drank WCM, as (milk volume) × 123 mg Ca/100 ml WCM.

e. Milk volumes were not explicitly given by the authors (29-30) but could be calculated from either (calories contributed in milk) ÷ $(\text{cal/ml of milk})_{\text{tabulated}}$ or (total calories) × (% of total calories contributed in milk) ÷ (cal/ml of milk). Milk Ca was recalculated as described in the outline of the Filer and Martinez surveys in the text.

Table 2. Milk intakes of boys and girls drinking human milk (HM), low-fat formulas (PF), or cow's milk (WCM or EV) and the influence of solid foods on milk intake.

	HM or PF no solid food (24, 25)						WCM, no solid food (22)			EV or PF-MO, solid food after 60 days (this paper)[b]					
	Girls			Boys			Boys			Boys			Girls		
	No.[a]	Mean ± S. D.		No.[a]	Mean ± S. D.		No.[a]	Mean ± S. D.		No.[a]	Mean ± S. D.		No.[a]	Mean ± S. D.	
15-30	7	776	98	12	826	165				5	774	56	4	749	39
31-60	14	803	142	20	934	217	2	712		8	776	134	10	693	57
61-90	11	812	156	16	885	171	9	748	40	9	793	69	10	675	128
91-130	17	919	95	31	952	201	20	819	54	12	771	48	9	737[d]	152
131-210	18	869[c]	146	29	1032	160	18	903	65	5	724	81	6	613	29

a. In our studies, No. refers to the number of children studied, and in the studies by Nelson (22) and Fomon *et al.* (24, 25) to the number of 3-day balance trials. Some of the children in the latter investigation were studied more than once in a 30-day interval.

b. Girl 1MO received solid food from day 11.

c. Underlined means ± S. D. were compared to the appropriate means ± S. D. of the boys studied by Fomon *et al.* (24, 25) by use of the T-test and were found to be significantly different ($P < 0.01$) (40).

d. Doubly underlined means ± S. D. were significantly different from both the boys and the girls studied by Fomon *et al.* (24, 25).

Table 3. Bulk intake of solid foods
(grams per day ±S. D.).

Age (days)	Case-days	Cereal	Fruits, juices and desserts	Vegetables and combinations	Meat and egg	Total
This paper						
32- 61	224	3± 5[a]	15± 24			18± 30
62- 89	280	5± 7	52± 42	5± 12		62± 44
90-126	308	11±11	128± 83	20± 42	5± 17	164± 95
167-200	84	23±14	157± 35	36± 29	45± 27	261± 55
201-238	56	26±20	136± 34	65± 9	68± 37	295± 55
311-348	70	10± 7	263±100	113± 32	47± 16	435±109
349-379	70	9± 7	292±124	113± 32	96± 54	515±141
446-490	84	5± 3	305±215	115± 52	112± 95	560±242
491-518	70	3± 2	367±289	98± 80	120±134	600±329
Kahn et al. (18)						
30- 60	336	50[b]	23	7		80
61- 90	672	71	52	22	1	146
91-120	868	88	87	42	5	222
121-150	924	92	108	55	15	270
151-180	896	98	131	73	18	320
181-210	700	86	147	70	20	323
211-240	812	87	153	85	25	350
241-270	504	84	171	97	32	384
271-300	280	88	180	117	28	413
Filer and Martinez (29, 30)[c]						
183	4130	9[a]	120	74	49	252
207	4146	9	113	87	49	258
Grand average (estimated)[d]						
61- 90		2[a]	15	5	0	22
91-180		7	62	40	20	129
181-270		9	117	80	49	255
271-360		8	229	115	50	424
361-540		6	320	108	109	558

Footnotes to Table 3

a. Dry cereal, fortified with calcium phosphate, iron and B vitamins. (36, 37).
b. Ready-to-eat cereal prepared with fruit rather than milk and fortified with iron and B vitamins only (37).
c. Weight of total or individual solid foods was not given by the authors (29, 30) but could be calculated from total calories tabulated for each food category, an average conversion factor (cal/tsp) also tabulated, for each food category and second conversion factor,(21 tsp = 100 g of fruits, meats, or vegetables), and (9 tsp = 7.1 g of dry cereal) (36).
d. Grand average of bulk solid food was estimated by assuming (a) the intake of prepared cereal in the Kahn et al. study (18) was too unusual to be included; (b) the Filer and Martinez data (29, 30) defined the 6-month point; (c) average infants younger than 6 months took in half the total bulk of solid food eaten by the infants in the balance studies included in this table; and (d) the balance study infants were representative of the average infant population after the ninth month.

Table 4. Calcium intake in solid foods.

	Individual food categories (mg per day ±S. D.)			
Age (days)	Cereal and baked goods	Fruit and juices	Vegetables and combinations[a]	Meat and egg
This paper				
32-611	14± 24	1± 1		
62- 89	35± 43	3± 2	2± 4	
90-126	53± 58	7± 5	4± 8	2± 5
167-200	107± 88	8± 2	9± 8	3± 1
201-238	142±134	8	14± 4	5± 4
311-348	53± 35	13± 5	18± 5	9± 5
349-379	51± 25	19± 9	22± 4	30±26
446-490	43± 21	16± 1	22±14	44±32
491-518	29± 17	19±17	18±17	35±42
Kahn et al. (18)				
31- 60	4[b]	2	2	
61- 90	6	5	5	
91-120	7	9	10	3
121-150	7	16	12	7
151-210	8	21	15	10
210-270	7	27	20	15
271-300	6	35	23	15
Filer and Martinez (29, 30)[c]				
152-213	54	7	21	13

Total calcium intake in solid food (mg/day ±S. D.)

	This paper	Kahn et al. (18)	Beal (26)[d]	Filer and Martinez (29, 30)	Grand average (estimated)[e]
0- 30			1		0
31- 60	15± 25	8	7		3
61- 90	41± 45	16	46		16
91-120	65± 59	29	57		25
121-150		42	64		54
151-210	127± 93	53	79	106	104
211-270	169±134	68	176		137
271-360	108± 48	79	243		143
361-450	126		258		192
451-540	102		242		172
630-720			176		176

Footnotes to Table 4.

a. More than half the calories and minerals of "dinners" and "high-meat dinners", which are combinations of vegetables and macaroni products and meat or cheese, are contributed by vegetables.
b. The ready-to-eat cereal has a lower Ca content, 8 mg/100 g, than dry baby cereals, 626 mg/100 g(36), and was excluded from the calculated average.
c. Calculated from weight of solid foods shown in Table 2 and the following average Ca concentrations (36): Dry cereal, 629 mg/100 g; fruits and juices, 7.1 mg/100 g; desserts 49.2 mg/100 g; vegetables and combinations 26.6 mg/100 g; and meat and eggs, 26 mg/100 g.
d. Solid food Ca was not stated explicitly, but could be estimated as the difference between total Ca (stated) and milk Ca (calculated as shown in footnote d to Table 1).
e. See footnote d, Table 3.

Table 5. Phosphorus intake in solid foods

Individual food categories (mg/day ±S. D.)

Age (days)	Cereal and baked goods	Fruit and juices	Vegetables and combinations[a]	Meat and egg
This paper				
32- 61	16± 29	2± 2		
62- 89	41± 51	5± 4	4± 8	
90-126	62± 68	12± 8	7±15	7± 20
167-200	148± 99	19± 5	16±15	39± 16
201-238	166±150	20± 6	24	74± 38
311-348	62± 45	21± 7	56±28	56± 22
349-379	61± 33	23±13	53±15	115±101
446-490	60± 45	35±36	44± 7	187±189
491-518	43± 37	35±38	37± 9	183±209
Kahn et al. (18)				
31- 60	22[b]	2	3	
61- 90	31	6	8	2
91-120	36	12	15	10
121-150	38	18	21	24
151-210	37	24	30	37
211-270	34	30	40	57
271-300	33	38	54	56
Filer and Martinez (29, 30)[c]				
152-213	61	9	34	64

Total phosphorus intake in solid food (mg/day ± S. D.)

	This paper	Kahn et al. (18)	Beal (26)	Filer and Martinez (29, 30)	Grand average (estimated)[e]
0- 30			15[d]		15
31- 60	18± 30	27	50		15
61- 90	54± 58	47	95		32
91-120	88± 76	73	124		95
121-150		101	149		101
151-210	222±117	128	180	178	175
211-270	284±194	162	286		250
271-360	195± 81	181	400		300
361-450	252±149		349		300
451-540	312±241		440		376

Footnotes to Table 5.

a. See footnote a, Table 4.
b. The ready-to-eat cereal has a lower P content, 32 mg/100 g, than dry baby cereals, 694 mg/100 g (36), and was excluded from the calculated average.
c. Calculated from weight of solid foods shown in Table 2 and the following average P concentrations (36): Dry cereal 689 mg/100 g, fruits and juices 9.5 mg/100 g, vegetables and combinations 42 mg/100 g, desserts 48.3 mg/100 g, and meat and eggs 130 mg/100 g.
d. Solid food P was not stated explicitly, but could be estimated as the difference between total P (stated) and calculated = milk P (milk volume) × (95 mg P/100 ml WCM) (19, 36)
e. See footnote d, Table 3.

Table 6. Sodium intake in solid foods.

Age (days)	Cereal and baked goods	Fruit and juices	Vegetables and combinations[a]	Meat and egg
	Individual food categories (mg/day ± S. D.)			
This paper				
32- 61	14± 25	4± 8		
62- 89	32± 44	16±14	23± 49	
90-126	56± 59	36±30	41± 94	12± 35
167-200	132± 89	73±21	74± 61	99± 60
201-238	147±132	64±18	128	151± 98
311-348	53± 40	25±16	290±130	112± 41
349-379	55± 28	41±25	292± 70	214±172
446-490	143±187	25±10	302± 96	327±264
491-518	139±204	27±15	232±161	251±326
Kahn et al. (18)[b]				
31- 60	53	5	19	2
61- 90	76	12	61	12
91-120	94	20	117	36
121-150	98	25	153	43
151-210	98	33	198	54
211-270	91	39	254	67
271-300	94	43	326	67
Filer and Martinez (29, 30)[b]				
152-213	57	23	225	117

Total intake of sodium in solid foods (mg/day ±S. D.)

	This paper	Kahn et al. (18)	Filer and Martinez (29, 30)	Grand average (estimated)[c]
31- 60	19± 31	79		25
61- 90	72± 77	161		58
91-120	145±160	267		103
121-150		319		160
151-210	377±168	383	450	403
211-270	491±246	451		471
271-360	481±182	530		505
361-450	601±278			601
451-540	725±403			725

Footnotes to Table 6.

a. See footnote a, Table 4.
b. Calculated from weight of solid food shown in Table 2 and the following average Na concentrations (36): Dry cereal 646 mg/100 g, ready-to-eat cereal 107 mg/100 g; fruit and juices 24.2 mg/100 g, desserts 137 mg/100 g, vegetables and combinations 271 mg/100 g, and meat and eggs 234 mg/100 g.
c. See footnote d, Table 3.

Table 7. Potassium intake in solid food

Individual food categories

(mg/day ±S. D.)

Age (days)	Cereal and baked goods	Fruits and juices	Vegetables and combinations[a]	Meat and egg
This paper				
32- 61	11± 21	21± 26		
62- 89	26± 37	54± 40	21± 35	
90-126	42± 54	131± 80	28± 59	12± 35
167-200	84± 57	192± 36	84± 69	102± 59
201-238	96± 86	153± 8	139	159±102
311-348	36± 25	227± 88	168± 43	94± 26
349-379	34± 17	269±154	199± 68	170±149
446-490	57± 59	453±518	223±185	239±247
491-518	46± 49	433±524	177±211	205±274
Kahn et al. (18)[b]				
31- 60	28	24	9	2
61- 90	39	54	29	10
91-120	48	91	55	31
121-150	51	113	65	38
151-210	50	146	94	47
211-270	47	170	119	59
271-300	48	189	153	58
Filer and Martinez(29, 30)[b]				
152-213	42	121	100	102

Total intake of potassium in solid foods
(mg/day ±S. D.)

	This paper	Kahn et al. (18)	Filer and Martinez (29, 30)	Grand average (estimated)[c]
31- 60	32± 43	63		24
61- 90	101± 82	132		58
91-120	212±159	225		110
121-150		267		133
151-210	462±115	337	373	391
211-270	547±194	395		471
271-360	524±172	448		486
360-450	672±370			672
450-540	914±956			914

Footnotes to Table 7.

a. See footnote a, Table 4.
b. Calculated from weight of solid food shown in Table 2 and the following average K concentrations (36): Dry cereal 484 mg/100 g; ready-to-eat cereal 55 mg/100 g; fruits and juices 109 mg/100 g; desserts 107 mg/100 g; vegetables and combinations 132 mg/100 g; meat and eggs 198 mg/100 g.
c. See footnote d, Table 3.

Table 8. Fraction of infants drinking human milk (HM), whole cow's milk (WCM), evaporated milk (EV), or ready-to-use formulas (PF) from 10 days to 10 months of age. Data from Cox (20), and Martinez (31) all shown in boldface; estimated values appear in standard type.

		Infant age (months)										
Year	Kind of milk	0.33	1	2	3	4	5	6	7	8	9	10
1953	HM	0.30[a]	0.23	←		Same as 1958			→			
	WCM	0.04	0.09	0.18	0.25	0.41	0.54	0.69	←Same as 1958→			
	EV	0.55	0.55	0.55	0.53	0.46	0.39	0.27	←Same as 1958→			
	PF	0.10	0.13	0.13	0.10	0.05	0.01	0				
1954	HM	0.30	0.23	←		Same as 1958			→			
	WCM	0.04	0.08	0.17	0.25	0.41	0.55	0.69	←Same as 1958→			
	EV	0.52	0.52	0.52	0.49	0.43	0.35	0.27	←Same as 1958→			
	PF	0.14	0.17	0.17	0.14	0.08	0.04	0				
1955	HM	0.30	0.23	←		Same as 1958			→			
	WCM	0.04	0.08	0.17	0.25	0.41	0.55	0.69	←Same as 1958			
	EV	0.49	0.50	0.50	0.47	0.40	0.35	0.27	←Same as 1958			
	PF	0.17	0.20	0.20	0.16	0.10	0.04	0				
1956	HM	0.29	0.22	←		Same as 1958			→			
	WCM	0.04	0.08	0.17	0.25	0.41	0.56	0.69	Same as 1958→			
	EV	0.47	0.47	0.47	0.46	0.39	0.32	0.25	Same as 1958→			
	PF	0.20	0.23	0.23	0.17	0.13	0.05	0.02	0			
1957	HM	0.29	0.22	←		Same as 1958			→			
	WCM	0.04	0.07	0.16	0.25	0.41	0.57	0.70	←Same as 1958→			
	EV	0.43	0.45	0.45	0.41	0.35	0.28	0.23	←Same as 1958→			
	PF	0.24	0.26	0.26	0.22	0.16	0.09	0.03	0			
1958	HM	**0.29**	**0.22**	**0.15**	**0.12**	**0.08**	0.06	0.04	0.02	0.01	0	
	WCM	**0.04**	**0.05**	**0.15**	**0.24**	**0.42**	0.56	0.69	0.83	0.90	0.96	1.00
	EV	**0.41**	**0.42**	**0.42**	**0.38**	**0.31**	0.26	0.21	0.15	0.09	0.04	0
	PF	**0.26**	**0.31**	**0.29**	**0.26**	**0.19**	0.12	0.06	0			
1959	HM	**0.29**	**0.20**	←		Same as 1958			→			
	WCM	0.04	**0.06**	0.16	0.25	**0.42**	0.57	0.71	0.84	0.91	0.97	1.00
	EV	0.41	**0.41**	0.38	0.34	**0.28**	0.23	0.16	0.10	0.07	0.03	0
	PF	0.26	**0.33**	0.31	0.28	**0.21**	0.15	0.08	0.03	0.01	0	
1960	HM	0.29	←			Same as 1958			→			
	WCM	0.03	**0.06**	0.16	0.26	**0.44**	0.58	0.72	0.87	0.97	0.98	1.00
	EV	0.38	**0.38**	0.35	0.31	**0.24**	0.19	0.13	0.07	0.02	0.01	0
	PF	0.30	**0.37**	0.35	0.31	**0.24**	0.17	0.11	0.04	0		
1961	HM	0.28	←			Same as 1958			→			
	WCM	0.03	**0.05**	0.13	0.23	**0.39**	0.54	0.70	0.87	0.98	1.00	
	EV	0.36	**0.36**	0.35	0.30	**0.25**	0.20	0.14	0.07	0.01	0	
	PF	0.33	**0.40**	0.38	0.34	**0.27**	0.20	0.12	0.04	0		
1962	HM	0.27	←		Same as 1958				→			
	WCM	0.02	**0.05**	0.13	0.22	**0.38**	0.56	0.72	0.88	0.98	1.00	
	EV	0.30	**0.30**	0.29	0.27	**0.21**	0.16	0.12	0.06	0.01	0	
	PF	0.38	**0.46**	0.43	0.39	**0.32**	0.22	0.12	0.04	0		

Year	Kind of milk	Infant age (months) 0.33	1	2	3	4	5	6	7	8	9	10
1963	HM	0.26	←	Same as 1958		→						
	WCM	0.02	0.04	0.10	0.20	0.39	0.55	0.71	0.88	0.98	1.00	
	EV	0.28	0.28	0.26	0.24	0.19	0.15	0.11	0.05	0.01	0	
	PF	0.44	0.49	0.49	0.45	0.33	0.24	0.14	0.05	0.0		
1964	HM	←	Same as 1965			→						
	WCM	0.01	0.04	0.10	0.20	0.40	0.55	0.71	0.89	0.98	1.00	
	EV	0.23	0.22	0.21	0.20	0.16	0.14	0.10	0.04	0.01	0	
	PF	0.51	0.54	0.54	0.48	0.36	0.25	0.15	0.05	0.0		
1965	HM	0.25	0.20	0.15	0.12	0.08	0.06	0.04	0.02	0.01	0	
	WCM	0.01	0.03	0.08	0.18	0.41	0.55	0.72	0.88	0.98	1.00	
	EV	0.19	0.19	0.18	0.18	0.13	0.11	0.07	0.03	0.01	0	
	PF	0.56	0.59	0.59	0.52	0.38	0.28	0.16	0.05	0		
1966	HM	←	Same as 1965			→						
	WCM	←	Same as 1965			→						
	EV	0.13	0.13	0.12	0.12	0.09	0.07	0.05	0.02	0		
	PF	0.61	0.64	0.64	0.57	0.43	0.32	0.19	0.08	0.01	0	
1967	HM	←			Same as 1965			→				
	WCM	←			Same as 1965			→				
	EV	0.09	0.09	0.09	0.08	0.07	0.04	0.01	0			
	PF	0.65	0.67	0.67	0.60	0.45	0.31	0.23	0.12	0.01	0	
1968	HM	←			Same as 1965			→				
	WCM	←			Same as 1965			→				
	EV	0.05	0.06	0.07	0.07	0.05	0.03	0.01	0			
	PF	0.69	0.70	0.70	0.63	0.49	0.33	0.23	0.12	0.01	0	

[a]See text for methods used to estimate missing values.

Table 9. Summary of calculated "average" mineral concentrations in milk drunk by infants and of daily mineral intakes in milk from birth through two years of age.

		Calcium		Phosphorus		Sodium		Potassium	
Age (days)	Milk volume (ml/day)[a]	Average milk concentration[b] 1958-1965 (mg/100 ml)	Daily intake in milk (mg/day)	Average milk concentration[b] 1958-1965 (mg/100 ml)	Daily intake in milk (mg/day)	Average milk concentration[b] 1958-1965 (mg/100 ml)	Daily intake in milk (mg/day)	Average milk concentration[b] 1958-1965 (mg/100 ml)	Daily intake in milk (mg/day)
10	570	70.4	401	53.5	305	33.1	189	86.2	491
30	780	74.0	577	56.8	443	34.6	271	89.6	699
60	840	82.6	694	64.4	541	38.4	322	99.0	832
90	840	88.3	742	69.2	581	41.5	349	104.1	874
120	840	103.5	869	83.2	699	49.2	413	121.2	1018
150	840	103.3	868	82.6	694	48.9	411	119.1	1004
180	840	111.5	937	89.6	753	52.7	443	127.5	1071
210	830	120.6	1010	97.1	806	57.1	474	136.7	1135
240	760	121.8	926	98.1	746	56.2	427	137.6	1046
270	700	122.9	860	99.0	693	55.3	387	138.5	970
300	670	123.0	824	↓	663	57.6	386	138.3	927
330	660	↓	812	↓	653	↓	380	↓	913
360	650	↓	800	↓	644	↓	374	↓	899
1st yr. avg.	765	108.0	826	86.3	660	50.5	386	123.9	948
540	590	123.0	726	199.0	584	157.6	340	138.3	816
720	530	↓	652	↓	525	↓	305	↓	733

a. Read from Fig. 1.

b. WCM (mg/100 ml): Ca, 123; P, 99; Na, 58; K, 138 (19, 36, 38).

HM (mg/100 ml): Ca, 33; P, 13; Na, 16; K, 50 (19, 25).

PF 1:1 dilution (mg/100 ml): Ca, 79±15; P, 60±15; Na, 34±9; K, 92±31.(This paper, 18, 19, 36, 46). Constant dilution assumed throughout.

EV 1:1 dilution (mg/100 ml): Ca, 120±14; P, 102±4; Na, 62; K, 146. (This paper, 18, 19, 36, 46). Dilution assumed to vary with age as follows: 0 to 30 days, water: EV: : 2:1; 31 to 60 days, water: EV: 1.5:1; 61 to 90 days, water: EV: : 19:13; greater than 91 days water: EV: : 1:1 (45).

Table 10. Average calcium intake in various milks and solid foods during the first 2 years of life of a cohort of infants born 1 January 1965.

Age (days)	Volume drunk (liters) $V = \int_{t_1}^{t_2} V_t \, dt$ [a]	Calcium contributed by various milks (g) [b] WCM	EV	PF	HM	Total milk (Ca(g))	Solid food Ca(g) $\int_{t_1}^{t_2} Ca_t \, dt$ [c]	Total Ca intake (g)
0 to 30	19.26	0.66	2.75	8.38	1.18	13.0	0.22	13.2
31 to 60	24.3	2.37	4.16	11.2	1.18	19.0	0.68	19.7
61 to 90	25.2	5.55	4.41	10.3	0.99	21.5	1.08	22.6
91 to 120		12.4	3.84	7.34	0.63	24.2	1.46	25.7
121 to 150		17.0	3.13	5.32	0.5	26.1	1.95	28.0
151 to 180	↓	22.0	1.81	2.75	0.32	27.0	2.40	29.4
181 to 210		27.6	0.84	0.38	0.14	29.1	2.78	31.9
211 to 240	24.0	28.2	0.44	0.20		29.0	3.00	32.0
241 to 270	21.9	26.5	0.27			26.8	3.60	30.4
271 to 300	20.25	25.3				25.3	4.05	29.4
301 to 330	19.95	24.5				24.5	4.35	28.8
331 to 360	19.65	24.2				24.2	4.72	28.9
Total 1st year		216.3	21.6	45.9	4.9	289.7		
361 to 540	111.6	137.3				137.3	33.4	170.7
541 to 720	100.8	123.1				123.1	34.2	157.3
Total 2nd year		260.4				260.4	67.6	328.0

Estimated total intake in solid food[d] (grams calcium per interval)

	Cereal and baked goods	Fruit and juices	Vegetables and combinations	Meat and eggs	Total
0 to 90	1.7	0.14	0.18	0	2.0
91 to 180	3.9	0.40	0.96	0.47	5.7
181 to 270	5.4	0.79	2.0	1.21	9.4
271 to 360	6.0	1.9	3.6	1.6	13.1
1st year total	17.0	3.2	6.7	3.3	30.2
2 nd year total	21.7	13.1	16.6	16.4	67.8

Footnotes to Table 10.

a. Month-by-month numerical integration of average daily milk volume curve in Fig. 1.

b. Calculated from Eq. 3; fr_{it} read from Table 8; C_i read from footnotes to Table 9.

c. Month-by-month numerical integration of average daily solid food calcium in Fig. 2.

d. Proportion of solid food Ca contributed by each class of solid food was calculated for each quarter from the proportions shown in Tables 3 and 4.

Table 11. Intake and retention of calcium by infants drinking various milks.

				Ca Retention				
					corrected[a]		Bone Ca increment(g)	
Age (days)	Milk product	Case-days	Ca intake (mg/day)	gross (mg/day)	(mg/day)	(%)	(0 to 1 yr)	Ref.
60 to 300	PF-S, dilute EV	6527	505[c]	180	158[b]	31.3	57.8	18
30 to 365	PF-MO	588	634[c]	181	159	25.1	58.0	This paper
30 to 130	EV	700	937[c]	255	232	24.8	84.7	This paper
0 to 60	EV, WCM	47	748	224	202			23
60 to 120	EV, WCM	558	819	239	217			23
120 to 180	EV, WCM	733	962	270	248			23
180 to 240	EV, WCM	296	1054	330	308			23
240 to 300	EV, WCM	132	1068	356	334			23
1st yr. avg.			953	296	274	28.8	100.	
0 to 60	HM	63	292	109	87			25
60 to 120	HM	63	305	157	135			25
120 to 180	HM	69	320	151	129			25
1st yr. avg.			313	145	123	39.3	44.9	25
0 to 180	PF-S	201	724	254	232	32.0	84.7	25
Avg. EV, PF, WCM			877[c]		247	28.2	90.2	

a. Corrected retention = gross retention -22 mg/day. Ca losses in sweat, drooled saliva, hair, nails, and desquamated skin estimated to amount to 22 mg/day (18, 47).
b. Corrected by the authors (18).
c. Intake includes solid foods. Other intakes are as stated by the authors (23, 25) or assumed (by us) to be milk only.

Table 12. Sample calculation of ^{90}Sr contribution of various milks and solid foods to the total ^{90}Sr intake of the cohort of infants born Jan. 1, 1965 in the northestern U. S.

	^{90}Sr (pCi/g Ca) of various milks 1965 New York City[a]				Average ^{90}Sr (pCi) contributed by various milks in 1965[c]					Average ^{90}Sr accumulated (pCi)	
	WCM	EV	PF	HM[b]	WCM	EV	PF	HM	Total	Total	±S. D.$^e_{Sr}$
1965											
Jan.	20.8	↑	↑	2.50	13.7	42.6	250.6	3.0	309.9	309.9	190
Feb.	18.0	15.5	29.9	2.16	42.7	64.5	327.0	2.5	436.7	746.6	401
Mar.	21.1	↓	↓	2.53	117.1	68.4	307.7	2.5	495.7	1242.3	609
April	19.0	↑	↑	2.28	235.8	76.8	226.8	1.4	540.8	1783.1	779
May	22.9	20.0	30.9	2.75	389.5	62.6	164.4	1.4	617.9	2401.0	934
June	18.0	↓	↓	2.16	396.5	36.2	85.0	0.7	518.4	2919.4	1086
July	18.0	↑	↑	2.16	497.5	21.8	7.0	0.3	526.6	3446.0	1203
Aug.	22.2	26.0	29.7	2.66	629.4	11.4	5.9		646.7	4092.7	1330
Sept.	16.5	↓	↓	1.98	437.4	7.0			444.4	4537.1	1420
Oct.	17.6	↑	↑	2.11	438.2				438.2	4975.3	1507
Nov.	17.6	18.0	27.6	2.11	431.9				431.9	5407.2	1590
Dec.	17.1	↓	↓	2.05	413.5				413.5	5820.7	1682
1966											
Jan.-June	13.9				1909				1909	7730	2095
July-Dec.	10.5				1293				1293	9023	2400

	Solid food ^{90}Sr (pCi)[d]					All milks ^{90}Sr (pCi)						Adult
	Cereal	Fruit	Veg.	Meat	Total	WCM	EV	PF	HM	Total	Grand total	Total[a]
0 to 6 mo	37	25	97	7	166	1195.3	351.1	1361.5	11.5	2919.4	3085	5034
7 to 12 mo	59	157	422	26	664	2847.9	40.2	12.9	0.3	2901.3	3565	3851
13 to 24 mo	96	686	941	134	1857	3202				3202.0	5059	6868

Footnotes to Table 12.

a. U. S. AEC Health and Safety Laboratory, Tri-City Diet and Infant Diet Surveys results (32, 49-53).
b. ^{90}Sr concentration of HM assumed to be 1/10 the ^{90}Sr concentration of the mother's diet (54), and approximately = 0.1 × 1.2 (WCM pC_i $^{90}Sr/g$ Ca).
c. ^{90}Sr contribution of various milks = (Ca(g) contribution) × (^{90}Sr pC_i/g Ca). See Table 10.
d. ^{90}Sr and stable Ca were measured in prepared baby foods only for the years 1959 through 1963 (10, 52). During those years the ^{90}Sr concentration (pC_i/g Ca) of baby fruit was 0.69 × the average (pC_i/g Ca) in the Tri-City diet analyses of canned fruit and fruit juices; the ^{90}Sr content of baby vegetables was 1.21 × the average (pC_i/g Ca) in the Tri-City diet analyses of fresh vegetables and canned vegetables; the ^{90}Sr content of baby meats was the same (pC_i/g Ca) as in the Tri-City diet analyses of meat, fish and eggs; and the ^{90}Sr concentration of baby cereals (low because of the addition of dicalcium phosphate to these products) was 0.123 × the average (pC_i/g Ca) of the Tri-City diet analyses of baked goods, whole grain products, flour, macaroni, and rice (50). Average ^{90}Sr concentrations in New York City diet samples for the years 1965 and 1966, respectively, were as follows: canned fruit and fruit juices, 77.8 and 76 pC_i/g Ca; canned vegetables and fresh vegetables, 64.6 and 46.8 pC_i/g Ca; meat, fish, and eggs, 10 and 8.2 pC_i/g Ca; baked goods, whole grain products, flour, macaroni, and rice, 48.1 and 36 pC_i/g Ca (51).
e. Total S. D. of ^{90}Sr intake includes differences in ^{90}Sr and Ca concentrations of the four milk varieties and the variation in milk intakes of individual children. See text.

Appendix 1a. Average daily intake of formula from 15 to 30 days of age.

Volume (fl oz/day)	Girls: 1 MO	Girls: 3 EV	Girls: 5 MO	All girls	Boys: 7 EV	Boys: 8 MO	Boys: 10 EV	All boys	Combined boys and girls: Grand average	Combined boys and girls: Between-child average
	Number of days volume was drunk									
15.1-16										
16.1-17										
17.1-18										
18.1-19										
19.1-20		2		2	1			1	3	
20.1-21		1		1	1			1	2	
21.1-22	1	5		6	2	1		3	9	
22.1-23		2	1	3	2	1		3	6	
23.1-24	4[a]	2		6	4	1		5	11	
24.1-25	1	2		3	1		1	2	5	
25.1-26	2	2		4			2	2	6	
26.1-27		2		2	2	1		3	5	
27.1-28		1	1	2		1	1	2	4	
28.1-29	1	1		2	1	1	1	3	5	
29.1-30							1	1	1	
30.1-31							2	2	2	
31.1-32										
32.1-33	1			1					1	
No. of days recorded	10	20	2	32	14	6	8	28	60	
Mean intake (fl oz)	25.4	23.5		24.2[c]	23.9	25.2	28.2	25.8	24.5	25.3
(ml)	751	695		716	707	745	835	764	723	747
$\pm$S. D.$_W$[b]	94	78			73	85	71			
$\pm$S. D.$_T$		86						92	88	
$\pm$S. D.$_B$, $\pm$S. D.$_F$, or $\pm$S. D.$_M$								86		65

Appendix 1b. Average daily intake of formula from 31 to 60 days of age.

Volume (fl oz/day)	Number of days volume was drunk: Girls 1MO	2EV	3EV	4EV	5MO	All girls	Boys 6EV	7EV	8MO	10EV	All boys	Combined boys and girls	
15.1-16					1	1			2		2	3	
16.1-17									1		1	1	
17.1-18	1	1	1	1		4			4		4	8	
18.1-19	1	1		1	1	4			2		2	6	
19.1-20	4	1	1		3	9			3		3	12	
20.1-21	2		4	2	3	11			3		3	14	
21.1-22	3	2	2	4	4	15		1	2		3	18	
22.1-23	5[a]	4	5	1	1	16		3	1		4	20	
23.1-24	7	2	1	2	1	13		5	1	2	8	21	
24.1-25	4		6	4	2	16		5	1	3	9	25	
25.1-26		2	1	1	4	8		7		1	8	16	
26.1-27	1	2	3	4	6	16		6	3	4	13	29	
27.1-28	1	7	4	3	2	17	1	2	3	6	12	29	
28.1-29		2	1	1		4	3		1	3	7	11	
29.1-30	1					1	3	1		2	5	6	
30.1-31			1			1	5		1	6	12	13	
31.1-32					1	1	4			3	7	8	
32.1-33					1	1	5		1		6	7	
33.1-34							4		1		5	5	
34.1-35													
35.1-36							2				2	2	
No. of days recorded	30	24	30	24	30	138	27	30	30	30	117	255	
												Grand average	Between-child average
Mean intake (fl oz)	22.8	24.7	24.2	24.2	24.0	23.9	31.5	25.1	22.6	28.2	26.7	24.9	25.3
(ml)	674	730	716	716	710	707	931	742	668	834	790	736	747
$\pm S.D._W$[b]	73	101	91	95	113		61	55	151	72			
$\pm S.D._T$						94					134	123	
$\pm S.D._B$, $\pm S.D._F$, or $\pm S.D._M$						25					116		87

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Appendix 1c. Average daily intake of formula from 61 to 90 days of age

Volume (fl oz/day)	Number of days volume was drunk: Girls 1MO	2EV	3EV	4EV	5MO	All girls	Boys 6EV	7EV	8MO	9EV	10EV	All boys	Grand average	Combined boys and girls / Between-child average
15.1-16	2	1		3		6								6
16.1-17	1			1		2								2
17.1-18	10		1	2		13								13
18.1-19	3[a]	2		2	1	8								8
19.1-20	1		2	3		6					1	1		7
20.1-21	5	3	3		2	13								13
21.1-22	1	5	3	2	4	15	1		1		1	3		18
22.1-23	4	2	3	1	1	11		2		2	1	5		16
23.1-24	1	5	1	6		13	1	6	1	5	5	18		31
24.1-25		5	3	4	1	13	1	6	1	2	5	15		28
25.1-26			2	3	6	11	2	6	4	1	3	16		27
26.1-27		3	2	2	4	11	1	5	7		5	18		29
27.1-28		2	1		5	8	3	2	2		3	10		19
28.1-29		2	3		1	6	3	3	4		3	13		19
29.1-30			3		3	6	5		3		1	9		15
30.1-31			2			2	1		2		1	4		6
31.1-32			1	1		2	5		2			7		9
32.1-33					1	1	4		1		1	6		7
33.1-34							2		1			3		3
34.1-35									1			1		1
35.1-36							1					1		1
36.1-37														
37.1-38					1	1								1
No. of days recorded	28	30	30	30	30	148	30	30	30	10	30	130		278
Milk intake (fl oz)	19.3	23.5	24.9	22.3	26.2	23.3	29.6	25.5	28.1	23.8	26.1	26.8	24.8	25.0
(ml)	571	695	736	659	775	681	875	754	831	704	772	793	733	737
±S. D.$_W$[b]	68	96	116	117	97		96	51	87		81			
±S. D.$_T$						126						94	121	
±S. D.$_B$, ±S. D.$_F$, or S. D.$_M$						79						67		87

Appendix 1d. Average daily intake of formula from 91 to 130 days of age.

Volume (fl oz/day)	Girls: 1MO	2EV	3EV	4EV	5MO	All girls	Boys: 6EV	7EV	8MO	9EV	10EV	All boys		Combined boys and girls
	Number of days volume was drunk													
15.1-16				3		3								3
16.1-17	2			3		5								5
17.1-18	4			7		11								11
18.1-19	5			6		11								11
19.1-20	10[a]			8		18								18
20.1-21	11			1		12		2		2	1	5		17
21.1-22	2	1		2		5	1				1	2		7
22.1-23	1	2				3		5		3		8		11
23.1-24					4	4	1	5	2	4	2	14		18
24.1-25					6	6	5	9	2	7	2	25		31
25.1-26		1			5	6	4	3	3	7	2	19		25
26.1-27		5			2	7	3	8	7	4	7	29		36
27.1-28		5	1		2	8	4	2	4	7	3	20		28
28.1-29		5	1		2	8	3	1	1	2	1	8		16
29.1-30		4			4	8	2		3		3	8		16
30.1-31		2	1		2	5	1	1	2		2	6		11
31.1-32		1				1	3					3		4
32.1-33														
33.1-34		2	1			3					1	1		4
34.1-35		2				2								2
No. of days recorded	35	30	4	30	28	127	27	36	24	36	25	148		275
													Grand average	Between-child average
Mean intake (fl oz)	19.9	28.6	30.1	18.6	25.9	23.3	27.2	25.0	27.2	25.3	26.9	26.2	24.6	25.0
(ml)	588	846	890	550	765	690	804	739	804	748	795	773	726	738
$\pm S.D._W$[b]	41	94		48	69		78	59	62	61	86			
$\pm S.D._T$						146						73	120	
$\pm S.D._B$, $\pm S.D._F$, or $\pm S.D._M$						142						34		101

Appendix 1e. Average daily intake of formula from 167 to 518 days of age two girls (1MO and 5 MO) and one boy (8MO).

Volume (fl oz/day)	167 to 238 days				311 to 379 days							
	1MO	5MO	8MO	All	1MO	5MO	8MO	All	1MO	5MO	8MO	All
< 16		5		5	3	4		7		11	18	29
16.1-17		3	1	4	4			4			1	1
17.1-18		2		2	5	2		7		1		1
18.1-19	4	4	3	11	10	4		14		4		4
19.1-20	6	2	6	14	7	3	1	11	3	5	1	9
20.1-21	40[a]	4	6	50	14	8		22		5	1	6
21.1-22	5	2	6	13	4	10	2	16	3	9	4	16
22.1-23	1	3	14	18	8	10		18	6	9	5	20
23.1-24		8	8	16		16	4	20	15	8	15	38
24.1-25		1	5	6	1		2	3	6	2	1	9
25.1-26			2	2			2	2	16		2	18
26.1-27			2	2			1	1	11	1		12
27.1-28			4	4			6	6	3	1		4
28.1-29			2	2			1	1				
29.1-30			1	1			1	1	1			1
30.1-31		1	2	3			2	2			3	3
31.1-32			1	1			2	2			2	2
> 32.1							6	6	2		2	4

	1MO	5MO	8MO	Grand average	Between-child average	1MO	5MO	8MO	Grand average	Between-child average	1MO	5MO	8MO	Grand average	Between-child average
No. of days recorded	56	35	63	154		56	57	30	143		66	56	56	178	
Mean intake (fl oz)	20.9	20.6	23.3	21.8	21.6	20.0	22.4	28.1	22.6	23.5	25.3	20.6	21.4	22.6	22.4
(ml)	618	609	689	645	639	591	662	830	669	694	748	609	633	668	663
±S. D. $_W$[b]	26	103	96			62	78	127			74	114	123		
±S. D. $_T$				90					122					145	
±S. D. $_B$					44					101					73

Footnotes to Appendices 1a-1e.

a. Median underlined.

b. $(S.D._T)^2 = (S.D._W)^2 + (S.D._B)^2$, where $S.D._T$ is the total standard deviation calculated by treating each daily intake of each child as an independent datum.

$S.D._W$ is the daily flucuation of an individual child about its own 30-day average.

$S.D._B$ is the variability of intake between children of both sexes calculated by treating as completely defined the average daily intake of each child (based on 6 or more days of observation).

$S.D._F$ and $S.D._M$ are the within-sex variability of girls and boys, respectively.

AGE DAYS*	ID NO.	SOLID FOODS — TOTAL INTAKE FOR 14 DAYS (KILOGRAMS) — PROCESSED BABY FOODS: CEREAL	FRUIT	VEG.	MEAT	JUICE	TABLE FOODS: BREAD	EGGS	PUDDINGS	DAIRY FOODS	FRESH FRUIT
34 GM	1MO	.196	.557								
49 GM	1MO	.194	1.178								
63 GM	1MO	.293	1.401								
77 GM	1MO	.414	1.904								
91 GM	1MO	.409	1.629								
105 GM	1MO	.564	1.904								
118 GM	1MO	.594	1.982								
189 GM	1MO	.563	1.987	.938	.750						
203 GM	1MO	.591	1.925	.603	1.350						
217 GM	1MO	.608	1.911	.871	1.400						
231 GM	1MO	.606	1.932	.804	1.400						
329 GM	1MO	.189	3.756	1.765	.700	.480		.352	.669		
343 GM	1MO	.280	3.506	1.919	.600	.960		.188	.191		
357 GM	1MO	.295	3.964	2.016	1.200	1.080		.752	.572		
371 GM	1MO	.098	4.671	1.970	1.500	1.780	.048	1.272			
469 GM	1MO	.149	5.348	2.611	1.900	2.520		1.410	.191		1.950
481 GM	1MO	.066	2.485	2.422	1.700	2.422		1.910	.191		1.950
495 GM	1MO	.066	4.584	2.606	1.600	2.606		1.910	.573		1.650
509 GM	1MO	.066	5.157	2.596	1.900	2.596		2.070	.382		1.800
44 GM	2EV										
58 GM	2EV					840					
72 GM	2EV		1.233								
86 GM	2EV	.213	1.080	1.584							
100 GM	2EV	.099	2.295	1.064	.400						
114 GM	2EV	.099	3.780	2.128	1.100						
18 GM	3EV										
32 GM	3EV										
46 GM	3EV	.026									
60 GM	3EV	.034	.254								
74 GM	3EV	.085	.945								
88 GM	3EV	.100	.765	.352							
44 GM	4EV										
58 GM	4EV	.085									
72 GM	4EV	.163	.338	.332							
86 GM	4EV	.130	.742	.598							
100 GM	4EV	.144	1.147	.732							
114 GM	4EV	.147	1.114	.665							
41 GM	5MO	.046	.429								
55 GM	5MO	.005	.601								
69 GM	5MO	.024	1.086								
83 GM	5MO	.028	1.016								
97 GM	5MO	.082	1.716								
111 GM	5MO	.092	1.816								
174 GM	5MO	.244	2.687		.353	.120					
188 GM	5MO	.252	2.803	.048	.471						
330 GM	5MO	.050	1.910	1.984	.600	1.271	.003		.764		

AGE DAYS*	ID NO.	SOLID FOODS — TOTAL INTAKE FOR 14 DAYS (KILOGRAMS) — PROCESSED BABY FOODS: CEREAL	FRUIT	VEG.	MEAT	JUICE	TABLE FOODS: BREAD	EGGS	PUDDINGS	DAIRY FOODS	FRESH FRUIT	MEAT
341 GM	5MO	.053	1.161	1.340	.500	1.500	.059		.191			
358 GM	5MO	.066	1.528	1.658	.670	.964	.079		.191			
372 GM	5MO	.062	1.528	.986	1.000	1.327	.031		.525			
469 GM	5MO	.043	1.305	.837	.367	.521	.066	.069	.382	.045		
483 GM	5MO	.038	1.241	.770	.500	.771	.027		.668	.040		
497 GM	5MO	.021	1.385	.737	.200	.480	.036	.055	.384			
511 GM	5MO	.038	1.145	.479	.200	.360		.082				
41 GM	6EV											
55 GM	6EV	.017										
69 GM	6EV	.031	.104			.214						
84 GM	6EV	.046	.067	.067		.357						
98 GM	6EV	.076	.067	.067		.557						
112 GM	6EV	.083	.067	.067		.600						
39 GM	7EV											
54 GM	7EV	.033	.202									
68 GM	7EV	.062	.878									
82 GM	7EV	.092	1.688									
96 GM	7EV	.099	2.835									
111 GM	7EV	.099	2.835									
125 GM	7EV	.099	2.835									
39 GM	8MO	.004	.028									
53 GM	8MO	.020	.384									
67 GM	8MO	.005	.186									
81 GM	8MO	.019	.528									
95 GM	8MO	.078	1.126									
109 GM	8MO	.081	1.514									
179 GM	8MO	.154	1.508	.917	.460	.320						
193 GM	8MO	.133	2.301	.534	.381	.284						
207 GM	8MO	.120	1.119	1.095	.467	.250						
221 GM	8MO	.131	1.830	.881	.547	.600						
318 GM	8MO	.133	1.774	.908	.311	.328	.071	.076				
348 GM	8MO	.142	2.071	1.255	.269	.291	.201	.062				
453 GM	8MO	.107	2.837	1.227	.800	.029	.489	.430			.275	
467 GM	8MO	.058	2.574	1.893	.450		.543	.316			.443	
481 GM	8MO	.045	2.064	1.499	.350	.077	.478	.584	.192	.051	.440	.180
495 GM	8MO	.014	1.676	.460	.250	.050	.495	.135	.573		.330	.055
96 GM	9EV	.099	2.835									
111 GM	9EV	.099	2.835									
125 GM	9EV	.099	2.835									
39 GM	10EV	.010										
53 GM	10EV	.011										
67 GM	10EV	.011	.033									
81 GM	10EV	.011	.066									
95 GM	10EV	.007	.066									
109 GM	10EV	.010	.066									

* AGE AT MID-POINT OF 14-DAY INTERVAL

Appendix 2.

CALCIUM --- GIRLS

TOTAL INTAKE FOR 14 DAYS (GRAMS)

AGE* DAYS	ID NO.	MILK CANS	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
34 CA	1MO	11.44	1.077	.029			1.106	7.230	8.336
49 CA	1MO	11.45	1.080	.061			1.141	7.236	8.377
63 CA	1MO	11.71	1.567	.076			1.643	7.401	9.044
77 CA	1MO	9.94	2.362	.102			2.428	6.282	8.710
91 CA	1MO	8.40	2.263	.086			2.349	6.450	8.799
105 CA	1MO	11.04	3.049	.101			3.150	6.977	10.127
118 CA	1MO	1056	3.214	.112	.091		3.417	6.674	10.091
189 CA	1MO	11.04	2.931	.108	.194	.058	3.291	6.911	10.202
203 CA	1MO	11.27	3.246	.112	.116	.105	3.579	7.055	10.634
217 CA	1MO	11.35	3.380	.111	.155	.113	3.759	7.105	10.864
231 CA	1MO	1131	3.316	.116	.170	.109	3.711	7.080	10.791
329 CA	1MO	10.17	1.018	.253	.314	.242	1.827	6.549	8.376
343 CA	1MO	1096	1.504	.283	.333	.155	2.275	7.058	9.333
357 CA	1MO	11.77	1.585	.360	.329	.311	2.585	7.580	10.165
371 CA	1MO	10.08	.529	.417	.387	.959	2.292	6.492	8.784
469 CA	1MO	13.46	1.019	.590	.529	1.116	3.254	7.739	10.993
481 CA	1MO	13.08	.579	.442	.493	1.158	2.672	7.521	10.193
495 CA	1MO	13.50	.639	.541	.530	1.094	2.804	7.762	10.566
509 CA	1MO	14.19	.639	.563	.532	1.255	2.989	8.159	11.148
44 CA	2EV	10.40						10.421	10.421
58 CA	2EV	11.50		.053			.053	11.523	11.576
72 CA	2EV	10.80		.068			.068	10.822	10.890
86 CA	2EV	12.00	1.318	.090	.371		1.779	12.024	13.803
100 CA	2EV	15.10	.530	.139	.220	.126	.915	15.130	16.045
114 CA	2EV	16.10	.568	.208	.466	.261	1.503	16.132	17.635
18 CA	3EV	8.30						8.317	8.317
32 CA	3EV	9.60						9.619	9.619
46 CA	3EV	9.10	.058				.058	9.118	9.176
60 CA	3EV	9.90	.067	.018			.085	9.920	10.805
74 CA	3EV	10.30	.148	.063			.211	10.321	10.532
88 CA	3EV	12.30	.172	.051	.081		.304	12.325	12.629
44 CA	4EV	11.59						11.613	11.613
58 CA	4EV	13.19	.443				.443	13.216	13.659
72 CA	4EV	13.25	.849	.020	.050		.919	13.276	14.195
86 CA	4EV	9.96	.732	.043	.087		.862	9.980	10.842
100 CA	4EV	9.92	.856	.067	.110		1.033	9.940	10.973
114 CA	4EV	10.23	.793	.065	.100		.958	10.250	11.208
41 CA	5MO	9.78	.279	.018			.297	7.652	7.949
55 CA	5MO	12.39	.032	.024			.056	9.626	9.682
69 CA	5MO	13.73	.146	.046			.192	8.677	8.869
83 CA	5MO	13.86	.173	.049			.222	8.760	8.982
97 CA	5MO	15.08	.501	.084			.585	9.530	10.115
111 CA	5MO	14.06	.554	.096			.650	8.886	9.536
174 CA	5MO	11.10	.879	.142		.028	1.049	6.948	7.997
188 CA	5MO	11.50	.740	.154	.008	.032	.934	7.199	8.133
330 CA	5MO	11.40	.268	.184	.302	.142	.896	7.342	8.238

* AGE AT MID-POINT OF 14-DAY INTERVAL

TOTAL INTAKE FOR 14 DAYS (GRAMS)

AGE DAYS	ID NO.	MILK CANS	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
341 CA	5MO	12.29	.302	.126	.202	.082	.712	7.915	8.627
358 CA	5MO	12.08	.370	.100	.238	.301	1.009	7.780	8.789
372 CA	5MO	11.21	.331	.145	.172	.268	.916	7.219	8.135
469 CA	5MO	11.94	.293	.084	.067	.268	.712	6.866	7.578
483 CA	5MO	10.35	.242	.081	.118	.304	.745	5.951	6.696
497 CA	5MO	11.12	.147	.087	.146	.160	.540	6.394	6.934
511 CA	5MO	11.02	.197	.072	.071	.183	.523	6.336	6.859

CALCIUM --- BOYS

AGE DAYS	ID NO.	MILK CANS	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
41 CA	6EV	12.50						12.525	12.525
55 CA	6EV	12.60	.090			.030	.120	12.625	12.745
69 CA	6EV	11.80	.160	.008	.026		.194	11.824	12.018
84 CA	6EV	11.70	.240	.019	.017		.276	11.723	11.999
98 CA	6EV	11.40	.394	.027	.024		.445	11.423	11.863
112 CA	6EV	12.20	.430	.029	.024		.483	12.224	12.617
39 CA	7EV	12.75						12.776	12.776
54 CA	7EV	13.48	.172	.013			.185	13.507	13.692
68 CA	7EV	14.21	.320	.057			.377	14.238	14.615
82 CA	7EV	13.32	.480	.110			.590	13.347	13.937
96 CA	7EV	13.81	.517	.185			.702	13.838	14.540
111 CA	7EV	13.58	.517	.185			.702	13.607	14.309
125 CA	7EV	12.91	.517	.185			.702	12.936	13.638
39 CA	8MO	13.60	.022				.022	8.595	8.617
53 CA	8MO	10.69	.114	.018			.132	6.756	6.888
67 CA	8MO	14.77	.031	.011			.042	9.335	9.377
81 CA	8MO	15.40	.106	.033			.139	9.733	9.872
95 CA	8MO	14.47	.439	.059			.498	9.145	9.643
109 CA	8MO	14.74	.452	.083			.535	9.316	9.851
179 CA	8MO	11.98	.842	.079	.186	.029	1.136	7.499	8.635
193 CA	8MO	12.92	.693	.119	.172	.027	1.011	8.088	9.099
207 CA	8MO	11.93	.627	.099	.280	.029	1.035	7.468	8.503
221 CA	8MO	13.09	.712	.113	.159	.039	1.023	8.194	9.217
318 CA	8MO	16.17	.689	.128	.178	.066	1.061	10.413	11.474
348 CA	8MO	13.62	.758	.148	.243	.054	1.203	8.771	9.974
453 CA	8MO	7.57	.856	.206	.298	.470	1.830	4.353	6.183
467 CA	8MO	8.86	.797	.214	.359	.305	1.675	5.094	6.769
481 CA	8MO	10.96	.617	.214	.296	.530	1.657	6.302	7.959
495 CA	8MO	7.34	.404	.176	.078	.143	.801	4.220	5.021
96 CA	9EV	13.86	.517	.185			.702	13.888	14.590
111 CA	9EV	13.53	.517	.185			.702	13.557	14.259
125 CA	9EV	13.55	.517	.185			.702	13.377	14.079
39 CA	10EV	12.10	.058				.058	12.124	12.182
53 CA	10EV	14.60	.057				.057	14.629	14.686
67 CA	10EV	13.50	.057	.004			.061	13.527	13.588
81 CA	10EV	14.00	.057	.008			.065	14.028	14.083
95 CA	10EV	13.90	.049	.008			.057	13.928	13.985
109 CA	10EV	14.90	.057	.008			.065	14.930	14.995

Appendix 3.

PHOSPHORUS --- GIRLS

TOTAL INTAKE FOR 14 DAYS (GRAMS)

AGE* DAYS	ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
34 P	1MO	1.282	.056			1.338	5.628	6.966
49 P	1MO	1.268	.113			1.481	5.633	7.114
63 P	1MO	1.887				1.887	5.761	7.648
77 P	1MO	2.704	.194			2.898	4.890	7.788
91 P	1MO	2.649	.140			2.789	5.141	7.930
105 P	1MO	3.584	.178			3.762	5.432	9.194
118 P	1MO	3.747	.204			3.951	5.196	9.147
189 P	1MO	3.630	.210	.410	.760	5.010	5.432	10.442
203 P	1MO	3.720	.230	.260	1.440	5.650	5.545	11.195
217 P	1MO	3.900	.250	.370	1.440	5.960	5.584	11.544
231 P	1MO	3.850	.250	.370	1.370	5.840	5.564	11.404
329 P	1MO	1.300	.390	.910	1.130	3.730	5.004	8.734
343 P	1MO	1.770	.430	1.030	1.080	4.310	5.392	9.702
357 P	1MO	1.860	.450	1.030	2.150	5.490	5.791	11.281
371 P	1MO	.720	.620	.800	4.220	6.360	4.959	11.319
469 P	1MO	.940	1.200	.730	5.650	8.520	6.622	15.142
481 P	1MO	.420	.920	.630	5.640	7.610	6.435	14.045
495 P	1MO	.420	1.080	.700	5.500	7.700	6.642	14.342
509 P	1MO	.420	1.100	.620	6.280	8.420	6.981	15.401
44 P	2EV						8.549	8.549
58 P	2EV		.067			.067	9.453	9.520
72 P	2EV		.091			.091	8.878	8.969
86 P	2EV	1.376	.127	.605		2.108	9.864	9.972
100 P	2EV	.633	.280	.360	.385	1.658	12.412	14.100
114 P	2EV	.625	.461	.914	1.301	2.301	13.234	15.535
18 P	3EV						6.823	6.823
32 P	3EV						7.891	7.891
46 P	3EV	.055				.055	7.480	7.535
60 P	3EV	.070	.020			.090	8.138	8.228
74 P	3EV	.180	.098			.278	8.467	8.745
88 P	3EV	.210	.079	.082		.371	10.111	10.482
44 P	4EV						9.527	9.527
58 P	4EV	.540				.540	10.842	11.382
72 P	4EV	1.035	.032	.078		1.145	10.892	12.037
86 P	4EV	.876	.072	.134		1.082	8.187	9.269
100 P	4EV	1.013	.110	.170		1.293	8.154	9.447
114 P	4EV	.958	.107	.156		1.221	8.409	9.630
41 P	5MO	.309	.042			.351	6.016	6.367
55 P	5MO	.038	.060			.098	7.566	7.664
69 P	5MO	.160	.102			.262	6.755	7.017
83 P	5MO	.191	.093			.284	6.819	7.103
97 P	5MO	.591	.193			.784	7.419	8.203
111 P	5MO	.650	.226			.876	6.918	7.794
174 P	5MO	1.615	.325		.275	2.215	5.461	7.676
188 P	5MO	1.664	.344	.016	.378	2.402	5.658	8.060
330 P	5MO	.280	.280	1.180	.830	2.570	5.609	8.179
341 P	5MO	.320	.230	.880	.730	2.160	6.047	8.207
358 P	5MO	.390	.220	1.060	1.000	2.670	5.943	8.613
372 P	5MO	.340	.260	.530	1.480	2.610	5.515	8.125
469 P	5MO	.360	.150	.500	.700	1.710	5.874	7.584
483 P	5MO	.270	.110	.500	.810	1.690	5.092	6.782
497 P	5MO	.180	.130	.520	.420	1.250	5.471	6.721
511 P	5MO	.240	.160	.270	.470	1.140	5.422	6.562

PHOSPHORUS --- BOYS

AGE DAYS	ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
41 P	6EV						10.275	10.275
55 P	6EV	.110			.110	.220	10.357	10.577
69 P	6EV	.195	.011	.031		.237	9.699	9.936
84 P	6EV	.292	.026	.020		.338	9.617	9.955
98 P	6EV	.480	.036	.024		.530	9.371	9.901
112 P	6EV	.525	.038	.024		.587	10.028	10.615
39 P	7EV						10.480	10.480
54 P	7EV	.210	.018			.228	11.080	11.308
68 P	7EV	.390	.078			.468	11.681	12.149
82 P	7EV	.585	.150			.735	10.949	11.684
96 P	7EV	.630	.252			.882	11.352	12.234
111 P	7EV	.630	.252			.882	11.163	12.045
125 P	7EV	.630	.252			.882	10.612	11.494
39 P	8MO	.022	.002			.024	6.591	6.715
53 P	8MO	.119	.039			.156	5.259	5.415
67 P	8MO	.032	.027			.059	7.267	7.326
81 P	8MO	.109	.067			.176	7.577	7.753
95 P	8MO	.449	.129			.578	7.119	7.697
109 P	8MO	.500	.162			.662	7.252	7.914
179 P	8MO	1.101	.209	.332	.597	2.239	5.894	8.133
193 P	8MO	.844	.279	.250	.486	1.860	6.357	8.217
207 P	8MO	.766	.183	.316	.605	1.866	5.870	7.736
221 P	8MO	.924	.255	.358	.700	2.237	6.440	8.677
318 P	8MO	.771	.233	.340	.479	1.813	7.956	9.769
348 P	8MO	.900	.220	.510	.410	2.040	6.701	8.741
453 P	8MO	1.630	.260	.470	1.790	4.150	3.724	7.874
467 P	8MO	1.450	.300	.910	1.130	3.790	4.359	8.149
481 P	8MO	1.280	.240	.740	1.950	4.210	5.392	9.602
495 P	8MO	1.110	.220	.230	.740	2.300	3.611	5.911
96 P	9EV	.630	.252			.882	13.888	14.770
111 P	9EV	.630	.252			.882	13.557	14.439
125 P	9EV	.630	.252			.882	13.377	14.259
39 P	10EV	.059				.059	9.946	10.005
53 P	10EV	.070				.070	12.001	12.071
67 P	10EV	.070	.009			.079	11.097	11.176
81 P	10EV	.070	.018			.088	11.508	11.596
95 P	10EV	.060	.018			.078	11.426	11.504
109 P	10EV	.070	.018			.088	12.248	12.336

*AGE AT MID-POINT OF 14-DAY INTERVAL

Appendix 4.

SODIUM --- GIRLS

TOTAL INTAKE FOR 14 DAYS (GRAMS)

AGE* DAYS		ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
34	NA	1MO	1.115	.212			1.327	3.398	4.725
49	NA	1MO	1.097	.414			1.511	3.401	4.912
63	NA	1MO	1.668	.579			2.247	3.478	5.725
77	NA	1MO	2.313	.800			3.113	2.952	6.065
91	NA	1MO	2.287	.507			2.794	3.107	5.901
105	NA	1MO	3.141	.707			3.848	3.279	7.127
118	NA	1MO	3.284	.908			4.212	3.136	7.348
189	NA	1MO	3.260	.800	1.880	1.570	7.410	3.279	10.689
203	NA	1MO	3.230	.990	1.100	3.130	8.450	3.347	11.797
217	NA	1MO	3.360	1.060	1.610	3.070	9.100	3.371	12.471
231	NA	1MO	3.350	1.100	1.980	3.100	9.530	3.359	12.889
329	NA	1MO	1.130	.570	4.720	2.240	8.660	3.020	11.680
343	NA	1MO	1.560	.670	4.850	2.150	9.230	3.255	12.485
357	NA	1MO	1.630	.820	5.430	4.310	12.190	3.496	15.686
371	NA	1MO	.580	.970	4.640	6.960	13.150	2.994	16.144
469	NA	1MO	.840	.710	5.750	8.850	16.150	3.998	20.148
481	NA	1MO	.370	.300	5.200	8.660	14.530	3.885	18.415
495	NA	1MO	.360	.610	5.770	8.440	15.180	4.010	19.190
509	NA	1MO	.360	.620	5.830	9.120	15.930	4.214	20.144
44	NA	2EV						4.670	4.670
58	NA	2EV		.027			.027	5.164	5.191
72	NA	2EV		.288			.288	4.849	5.137
86	NA	2EV	1.445	.098	4.245		5.788	5.388	11.176
100	NA	2EV	.598	1.243	2.517	.716	5.074	6.780	11.854
114	NA	2EV	.501	1.550	5.349	2.206	8.606	7.229	15.835
18	NA	3EV						3.727	3.727
32	NA	3EV						4.310	4.310
46	NA	3EV	.062				.062	4.041	4.103
60	NA	3EV	.074	.016			.090	4.445	4.535
74	NA	3EV	.172	.249			.421	4.625	5.046
88	NA	3EV	.200	.202	.684		1.086	5.523	6.609
44	NA	4EV						5.204	5.204
58	NA	4EV	.515				.515	5.922	6.437
72	NA	4EV	.987	.068	.530		1.585	5.949	7.534
86	NA	4EV	.831	.148	.918		1.897	4.472	6.369
100	NA	4EV	.959	.230	1.166		2.355	4.454	6.809
114	NA	4EV	.911	.223	1.060		2.194	4.593	6.787
41	NA	5MO	.252	.126			.378	3.636	4.014
55	NA	5MO	.031	.192			.223	4.572	4.795
69	NA	5MO	.134	.305			.439	4.078	4.517
83	NA	5MO	.156	.261			.417	4.116	4.533
97	NA	5MO	.489	.656			1.145	4.479	5.624
111	NA	5MO	.537	.845			1.382	4.176	5.558
174	NA	5MO	1.400	1.278		.700	3.378	3.297	6.675
188	NA	5MO	1.450	1.440	.095	1.010	3.995	3.416	7.411
330	NA	5MO	.280	.210	6.390	1.660	8.540	3.386	11.926
341	NA	5MO	.180	.210	4.460	1.260	6.110	3.650	9.760
358	NA	5MO	.350	.270	5.340	2.140	8.100	3.588	11.688
372	NA	5MO	.350	.230	2.880	2.750	6.210	3.329	9.539
469	NA	5MO	.460	.290	2.720	1.570	5.040	3.546	8.586
483	NA	5MO	.290	.220	2.870	1.810	5.190	3.074	8.264
497	NA	5MO	.210	.220	3.340	.930	4.700	3.303	8.003
511	NA	5MO	.230	.270	1.520	1.050	3.070	3.273	6.343

SODIUM --- BOYS

AGE* DAYS		ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
41	NA	6EV						5.612	5.612
55	NA	6EV	.104			.073	.177	5.657	5.834
69	NA	6EV	.186	.004	.193		.383	5.298	5.681
84	NA	6EV	.279	.035	.125		.439	5.253	5.692
98	NA	6EV	.458	.039	.142		.639	5.119	5.758
112	NA	6EV	.500	.040	.142		.682	5.478	6.160
39	NA	7EV						5.725	5.725
54	NA	7EV	.200	.031			.231	6.052	6.283
68	NA	7EV	.372	.136			.508	6.380	6.888
82	NA	7EV	.558	.262			.810	5.981	6.791
96	NA	7EV	.601	.441			1.042	6.201	7.243
111	NA	7EV	.601	.441			1.042	6.097	7.149
125	NA	7EV	.601	.441			1.042	5.796	6.838
39	NA	8MO	.018	.002			.020	4.039	4.059
53	NA	8MO	.095	.155			.250	3.175	3.425
67	NA	8MO	.026	.115			.141	4.387	4.528
81	NA	8MO	.087	.250			.337	4.574	4.911
95	NA	8MO	.360	.476			.836	4.298	5.134
109	NA	8MO	.407	.584			.991	4.378	5.369
179	NA	8MO	.920	.718	1.722	1.086	3.618	3.558	7.176
193	NA	8MO	.797	.893	1.429	.828	3.947	3.837	7.784
207	NA	8MO	.722	.664	1.995	1.092	4.473	3.543	8.016
221	NA	8MO	.784	.785	1.615	1.207	4.391	3.888	8.279
318	NA	8MO	.637	.234	1.991	1.057	3.919	4.802	8.721
348	NA	8MO	.850	.200	3.100	.900	5.050	4.045	9.095
453	NA	8MO	4.810	.330	3.220	2.870	11.230	2.248	13.478
467	NA	8MO	5.090	.330	5.470	1.740	12.630	2.631	15.261
481	NA	8MO	5.160	.260	4.520	1.950	11.890	3.255	15.145
495	NA	8MO	5.240	.280	1.510	.770	7.800	2.180	9.980
96	NA	9EV	.601	.441			1.041	6.223	7.264
111	NA	9EV	.601	.441			1.041	6.075	7.116
125	NA	9EV	.601	.441			1.041	5.994	7.035
39	NA	10EV	.058				.058	5.433	5.491
53	NA	10EV	.067				.067	6.555	6.622
67	NA	10EV	.067	.021			.088	6.062	6.150
81	NA	10EV	.067	.042			.109	6.286	6.395
95	NA	10EV	.057	.042			.099	6.241	6.340
109	NA	10EV	.067	.042			.109	6.690	6.799

* AGE AT MID-POINT OF 14-DAY INTERVAL

Appendix 5.

POTASSIUM --- GIRLS

TOTAL INTAKE FOR 14 DAYS (GRAMS)

AGE DAYS	ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
34 K	1MO	.944	.611			1.555	7.116	8.671
49 K	1MO	.918	1.288			2.206	7.122	9.328
63 K	1MO	1.476	1.523			2.999	7.284	10.283
77 K	1MO	1.897	2.141			4.038	6.183	10.221
91 K	1MO	1.925	1.669			3.594	6.701	10.295
105 K	1MO	2.771	2.081			4.852	6.367	11.719
118 K	1MO	2.911	2.165			5.076	6.568	11.644
189 K	1MO	2.032	2.152	2.097	1.675	7.956	6.867	14.823
203 K	1MO	2.131	2.213	1.120	3.088	8.552	7.010	15.562
217 K	1MO	2.238	2.205	1.929	3.249	9.621	7.060	16.681
231 K	1MO	2.199	2.246	1.894	3.214	9.553	7.035	16.588
329 K	1MO	.730	4.410	2.870	1.510	9.520	6.326	15.846
343 K	1MO	1.010	4.380	3.210	1.910	10.510	6.817	17.327
357 K	1MO	1.060	5.230	3.220	3.830	13.340	7.321	20.661
371 K	1MO	.350	7.280	4.120	5.700	17.450	6.270	23.720
469 K	1MO	.530	16.130	6.200	7.360	30.220	8.372	38.592
481 K	1MO	.240	13.310	5.730	7.020	26.300	8.136	34.436
495 K	1MO	.240	13.970	6.050	6.750	27.010	8.397	35.407
509 K	1MO	.240	15.110	5.740	7.810	28.900	8.826	37.726
44 K	2EV						11.253	11.253
72 K	2EV		1.138			1.138	11.686	12.824
86 K	2EV	.588	1.310	2.892		4.790	12.984	17.774
58 K	2EV		1.273			1.273	12.443	13.716
100 K	2EV	.345	3.149	1.529	.804	5.827	16.338	22.165
114 K	2EV	.374	4.091	3.336	2.119	9.920	17.420	27.340
18 K	3EV						8.981	8.981
32 K	3EV						10.887	10.887
46 K	3EV	.018				.018	9.846	9.864
60 K	3EV	.029	.205			.234	10.712	10.946
74 K	3EV	.100	.710			.810	11.114	11.924
88 K	3EV	.117	.575	.756		1.448	13.309	14.757
44 K	4EV						12.540	12.540
58 K	4EV	.300				.300	14.272	14.572
72 K	4EV	.575	.300	.475		1.350	14.336	15.686
86 K	4EV	.646	.660	.823		2.129	10.777	12.906
100 K	4EV	.869	1.020	1.045		2.934	10.733	13.667
114 K	4EV	.619	.990	.955		2.564	11.069	13.633
41 K	5MO	.189	.574			.763	7.846	8.609
55 K	5MO	.023	.847			.870	9.858	10.728
69 K	5MO	.100	1.425			1.525	8.450	9.975
83 K	5MO	.117	1.160			1.277	8.621	9.898
97 K	5MO	.351	1.960			2.311	9.380	11.691
111 K	5MO	.387	2.087			2.474	8.745	11.219
174 K	5MO	.920	3.410		.810	5.140	6.904	12.044
188 K	5MO	.940	2.980	.110	1.020	5.050	7.153	12.203
330 K	5MO	.180	3.300	2.670	1.340	7.490	7.091	14.581

TOTAL INTAKE FOR 14 DAYS (GRAMS)

AGE DAYS	ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
341 K	5MO	.190	3.110	1.460	1.180	5.940	7.644	13.584
358 K	5MO	.240	2.660	1.930	1.010	5.840	7.514	13.354
372 K	5MO	.220	2.730	1.620	2.050	6.620	6.973	13.593
469 K	5MO	.330	1.860	.920	.490	3.600	7.427	11.027
483 K	5MO	.190	2.140	.910	.560	3.800	6.438	10.238
497 K	5MO	.150	2.280	1.110	.290	3.830	6.917	10.747
511 K	5MO	.130	1.580	.540	.330	2.580	6.854	9.434

POTASSIUM --- BOYS

AGE DAYS	ID NO.	CER	FRUIT	VEG	MEAT	SOLID TOTAL	MILK	GRAND TOTAL
41 K	6EV						13.525	13.525
55 K	6EV	.061			.027	.088	13.633	13.721
69 K	6EV	.108	.204	.196		.508	12.768	13.276
84 K	6EV	.162	.412	.127		.701	12.659	13.360
98 K	6EV	.266	.605	.129		1.000	12.335	13.335
112 K	6EV	.292	.645	.129		1.066	13.200	14.266
39 K	7EV						13.796	13.796
54 K	7EV	.117	.199			.316	14.585	14.901
68 K	7EV	.216	.864			1.080	15.375	16.455
82 K	7EV	.325	.166			.491	14.412	14.903
96 K	7EV	.350	2.793			3.143	14.942	18.085
111 K	7EV	.350	2.793			3.143	14.694	17.837
125 K	7EV	.350	2.793			3.143	13.969	17.112
39 K	8MO	.013	.021			.033	8.459	8.492
53 K	8MO	.071	.408			.479	6.649	7.128
67 K	8MO	.019	.217			.236	9.187	9.423
81 K	8MO	.065	.648			.713	9.579	10.292
95 K	8MO	.269	1.312			1.581	9.000	10.581
109 K	8MO	.193	1.635			1.828	9.168	10.996
179 K	8MO	.627	2.335	2.017	1.079	6.058	7.451	13.509
193 K	8MO	.460	3.051	1.640	.947	6.098	8.036	14.134
207 K	8MO	.416	1.509	2.068	1.103	5.096	7.420	12.516
221 K	8MO	.524	2.625	1.910	1.346	6.405	8.142	14.547
318 K	8MO	.453	1.921	1.959	.990	5.323	10.057	15.380
348 K	8MO	.490	2.360	2.930	.850	6.630	8.472	15.102
453 K	8MO	1.940	2.490	2.160	2.870	9.460	4.708	14.168
467 K	8MO	1.860	2.540	3.080	1.690	9.170	5.511	14.681
481 K	8MO	1.450	1.960	2.220	2.360	8.760	6.817	15.577
495 K	8MO	1.380	1.710	.710	1.040	4.840	4.565	9.405
96 K	9EV	.350	2.793			3.145	14.996	18.139
111 K	9EV	.350	2.793			3.145	14.639	17.784
125 K	9EV	.350	2.793			3.145	14.445	17.590
39 K	10EV	.028				.028	13.092	13.120
53 K	10EV	.039				.039	15.797	15.836
67 K	10EV	.039	.079			.118	14.607	14.725
81 K	10EV	.039	.158			.197	15.148	15.315
95 K	10EV	.033	.158			.191	15.040	15.231
109 K	10EV	.039	.158			.197	16.122	16.319

AGE AT MID-POINT OF 14-DAY INTERVAL

Appendix 6.

FIGURE LEGENDS

Fig. 1. Daily volume of milk drunk by infants given human milk, whole cow's milk, evaporated milk, or low-mineral prepared formulas.

Fig. 2. Daily calcium intake of infants given human milk, whole cow's milk, evaporated milk, or low-mineral prepared formulas.

Fig. 3. Daily phosphorus intake of infants given human milk, whole cow's milk, evaporated milk, or low-mineral prepared formulas.

Fig. 4. Daily sodium intake of infants given human milk, whole cow's milk, evaporated milk, or low-mineral prepared formulas.

Fig. 5. Daily potassium intake of infants given human milk, whole cow's milk, evaporated milk, or low-mineral prepared formulas.

Fig. 6. Fraction of total number of infants fed various milks from birth through 10 months of age during calendar year 1965. Data of Cox (20).

Fig. 7. Fraction of total number of 1-month-old infants fed various milks from 1950 through 1968. Data of Cox (20) and Martinez (31).

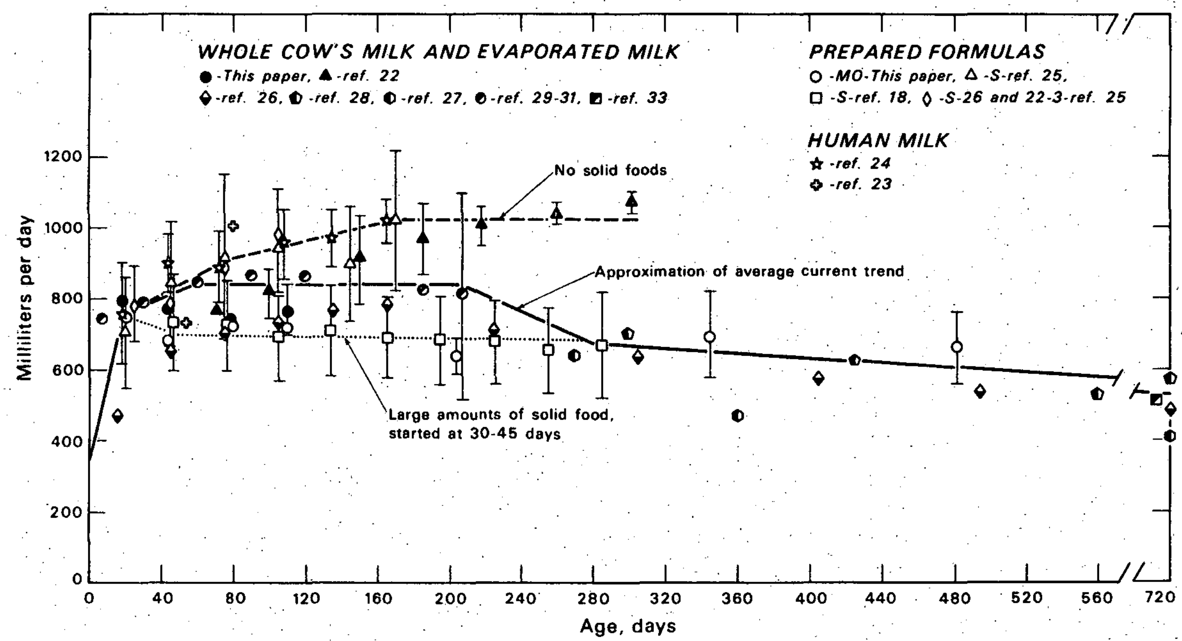
WHOLE COW'S MILK AND EVAPORATED MILK
● -This paper, ▲ -ref. 22
◆-ref. 26, -ref. 28, -ref. 27, -ref. 29-31, -ref. 33
PREPARED FORMULAS
○ -MO-This paper, △ -S-ref. 25,
□ -S-ref. 18, ◊ -S-26 and 22-3-ref. 25
HUMAN MILK
☆ -ref. 24
✥ -ref. 23
No solid foods
Approximation of average current trend
Large amounts of solid food, started at 30-45 days
Milliliters per day
Age, days
0
200
400
600
800
1000
1200
40
80
120
160
200
240
280
320
360
400
440
480
520
560
720

Fig. 1

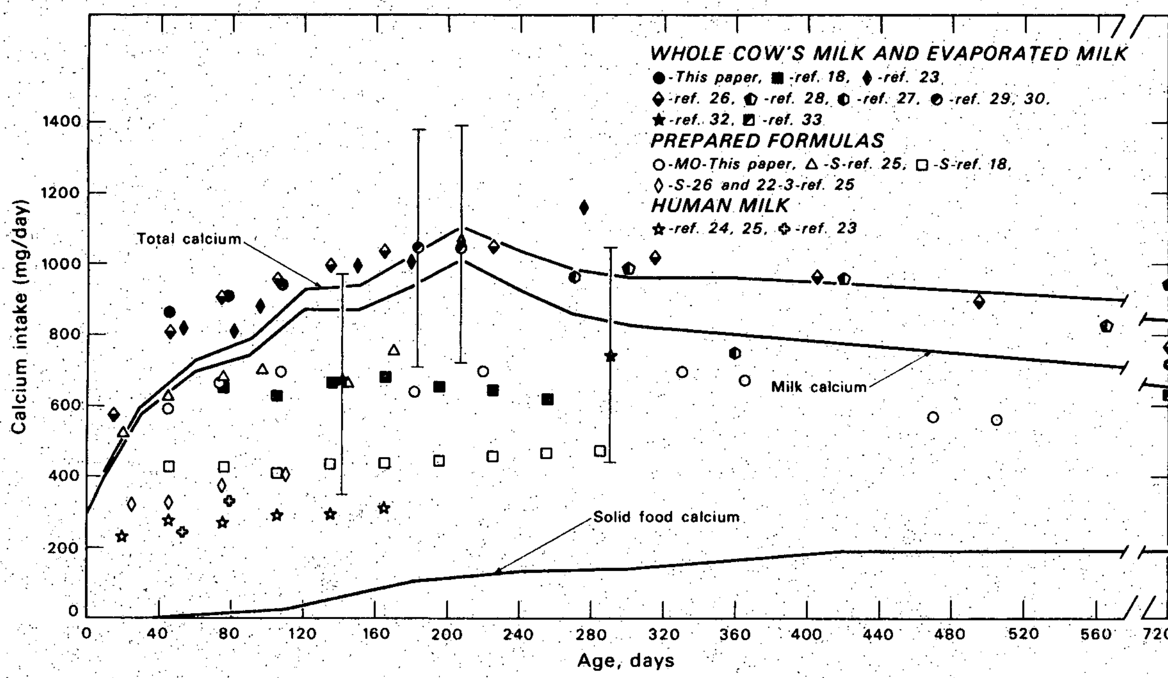
WHOLE COW'S MILK AND EVAPORATED MILK
●-This paper, ■-ref. 18, ♦-ref. 23
-ref. 26, -ref. 28, -ref. 27, -ref. 29, 30,
★-ref. 32, -ref. 33
PREPARED FORMULAS
○-MO-This paper, △-S-ref. 25, □-S-ref. 18,
◊-S-26 and 22-3-ref. 25
HUMAN MILK
☆-ref. 24, 25, -ref. 23
Total calcium
Milk calcium
Solid food calcium
Calcium intake (mg/day)
1400
1200
1000
800
600
400
200
0
0
40
80
120
160
200
240
280
320
360
400
440
480
520
560
720
Age, days

Fig. 2

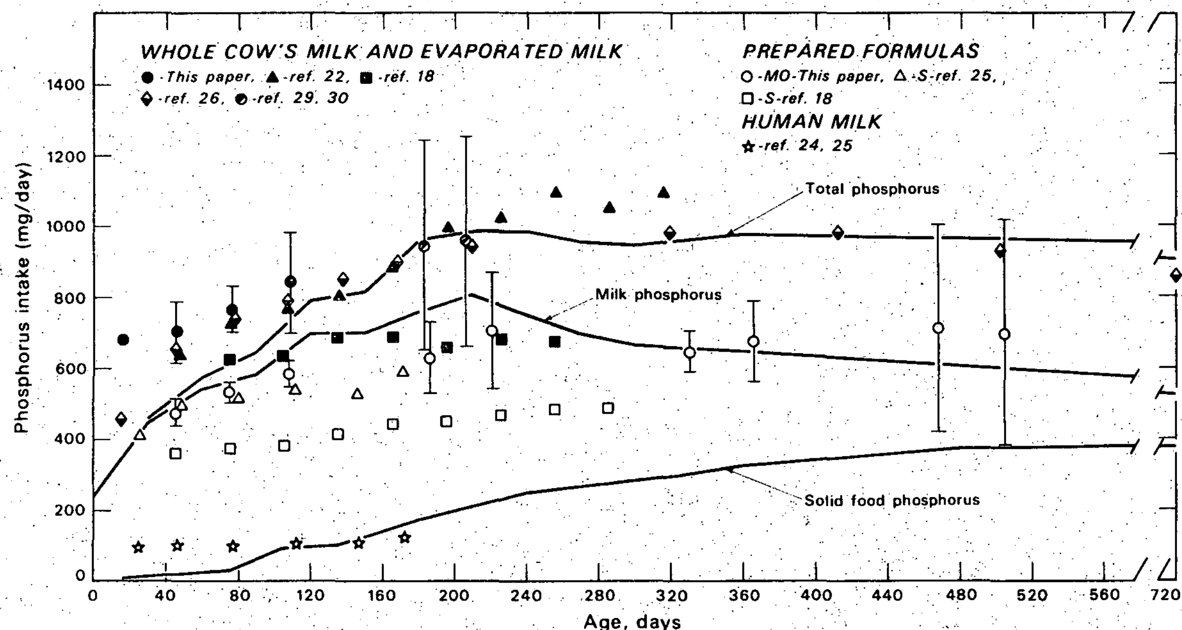
WHOLE COW'S MILK AND EVAPORATED MILK
● -This paper, ▲-ref. 22, ■-ref. 18
◆-ref. 26, ◐-ref. 29, 30
PREPARED FORMULAS
○-MO-This paper, △-S-ref. 25,
□-S-ref. 18
HUMAN MILK
☆-ref. 24, 25
Total phosphorus
Milk phosphorus
Solid food phosphorus
Phosphorus intake (mg/day)
Age, days
0
200
400
600
800
1000
1200
1400
40
80
120
160
200
240
280
320
360
400
440
480
520
560
720

Fig. 3

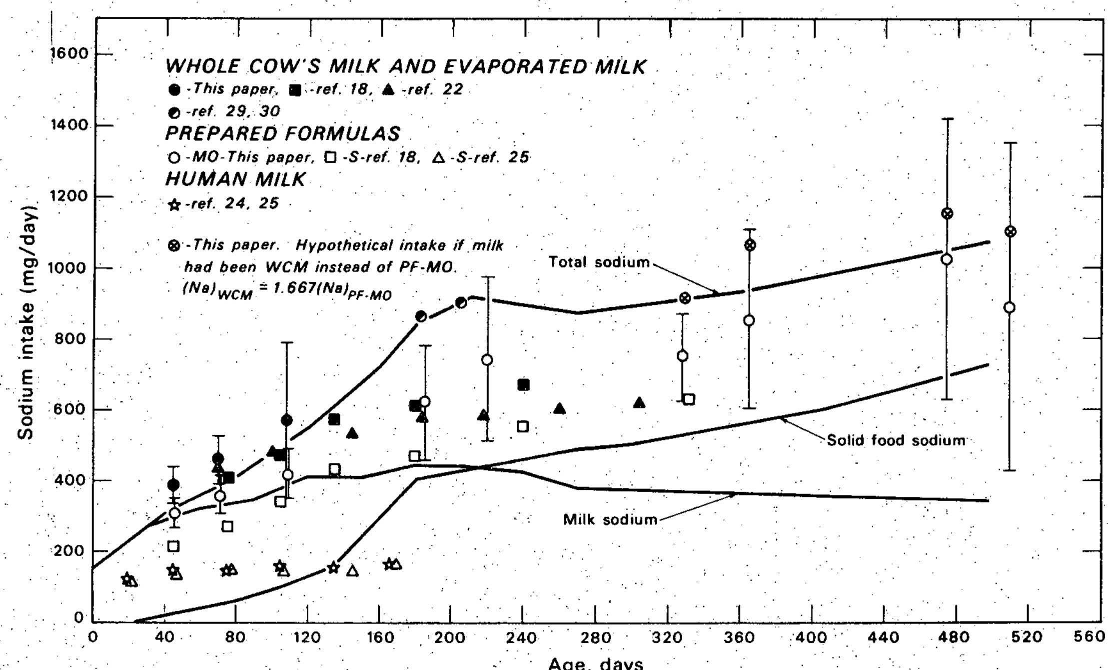
WHOLE COW'S MILK AND EVAPORATED MILK
● -This paper, ■ -ref. 18, ▲ -ref. 22
-ref. 29, 30
PREPARED FORMULAS
○ -MO-This paper, □ -S-ref. 18, △ -S-ref. 25
HUMAN MILK
☆ -ref. 24, 25
⊗ -This paper. Hypothetical intake if milk had been WCM instead of PF-MO.
$(Na)_{WCM} = 1.667(Na)_{PF\text{-}MO}$
Total sodium
Solid food sodium
Milk sodium
Sodium intake (mg/day)
Age, days
0
200
400
600
800
1000
1200
1400
1600
40
80
120
160
200
240
280
320
360
400
440
480
520
560

Fig. 4

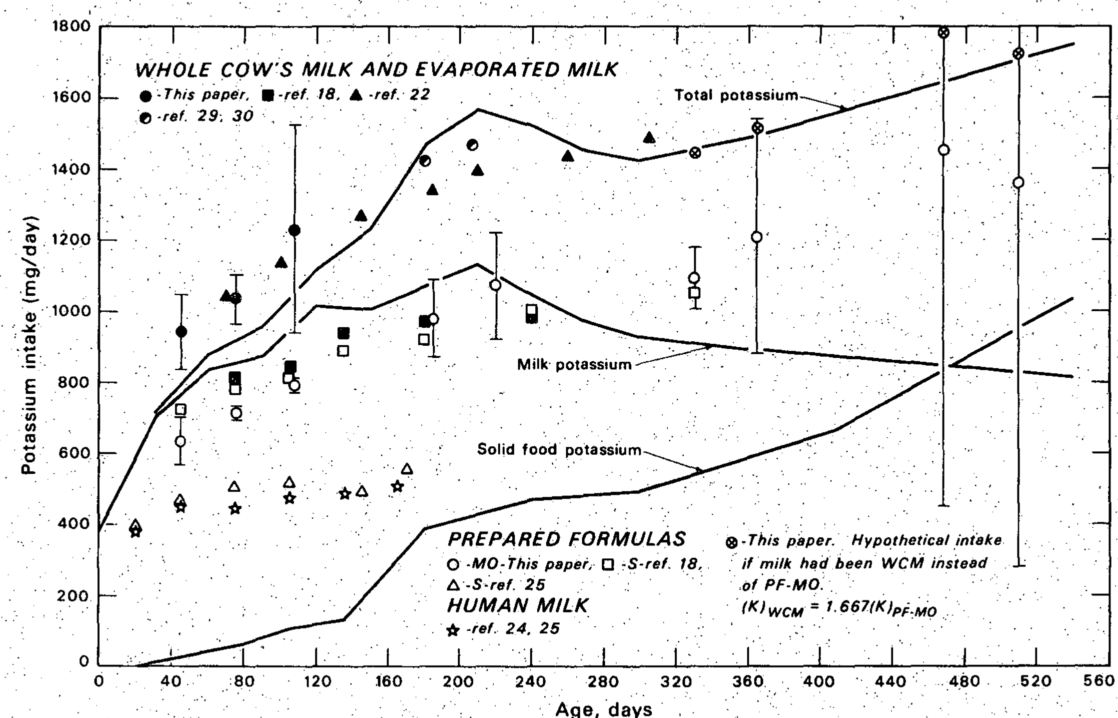
WHOLE COW'S MILK AND EVAPORATED MILK
● -This paper, ■ -ref. 18, ▲ -ref. 22
◐ -ref. 29, 30
Total potassium
Milk potassium
Solid food potassium
PREPARED FORMULAS
○ -MO-This paper, □ -S-ref. 18,
△ -S-ref. 25
HUMAN MILK
☆ -ref. 24, 25
⊗ -This paper. Hypothetical intake if milk had been WCM instead of PF-MO.
(K)WCM = 1.667(K)PF-MO
Potassium intake (mg/day)
Age, days
0
200
400
600
800
1000
1200
1400
1600
1800
40
80
120
160
200
240
280
320
360
400
440
480
520
560

Fig. 5

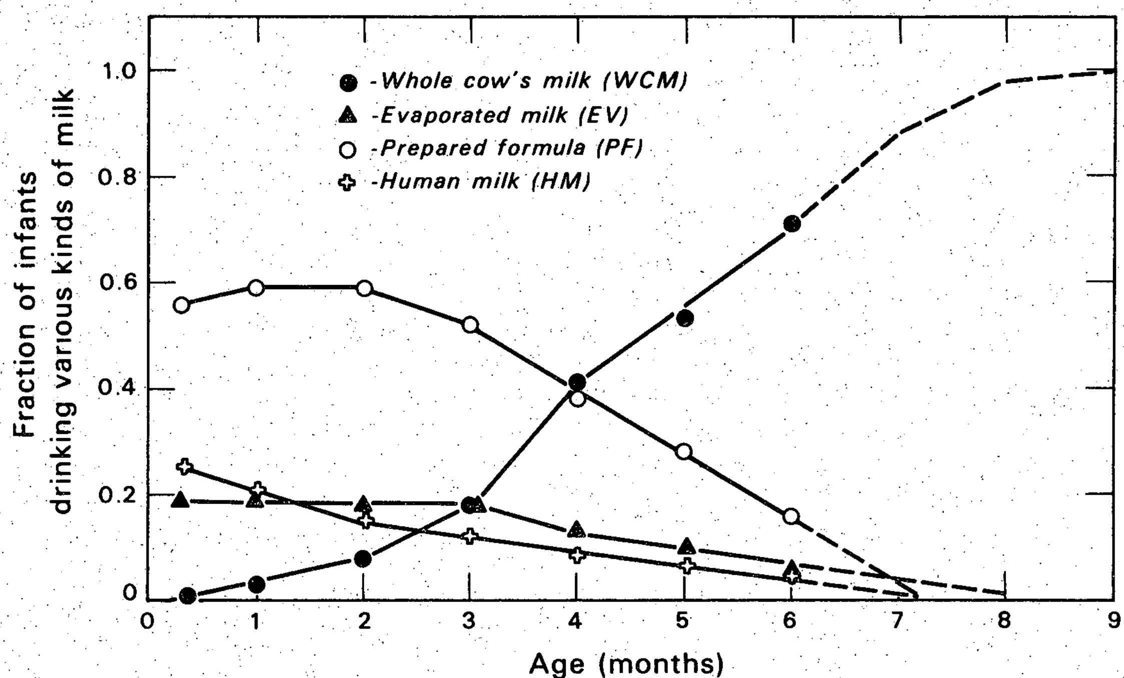
1.0
0.8
0.6
0.4
0.2
0
Fraction of infants drinking various kinds of milk
● -Whole cow's milk (WCM)
▲ -Evaporated milk (EV)
○ -Prepared formula (PF)
✚ -Human milk (HM)
0 1 2 3 4 5 6 7 8 9
Age (months)

Fig. 6

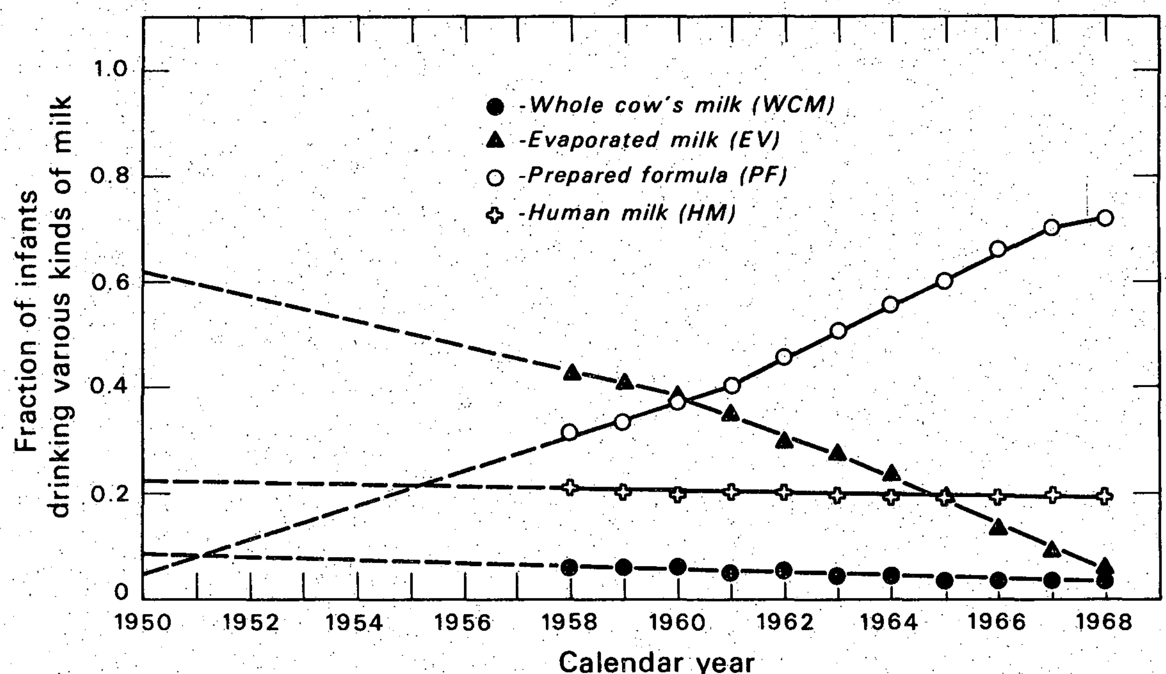
Fraction of infants drinking various kinds of milk
1.0
0.8
0.6
0.4
0.2
0
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
Calendar year
-Whole cow's milk (WCM)
-Evaporated milk (EV)
-Prepared formula (PF)
-Human milk (HM)

Fig. 7

TECHNICAL INFORMATION DIVISION
LAWRENCE RADIATION LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720