AN ABSTRACT OF THE THESIS OF

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Title: THE EFFECT OF SELECTED SOCIO-ENVIRONMENTAL VARIABLES ON THE DIETARY INTAKE OF PRESCHOOL CHILDREN

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This investigation was undertaken to obtain information on the dietary intake of Oregon preschool children and to determine the effect of certain socio-environmental variables on the nutrient intake of these children. Three hundred boys and girls who were attending Well Child or Multiphasic Screening Clinics in 11 counties participated in this project. A home economist interviewed the parent to obtain the child's dietary intake and socio-environmental data of the family. Dietary intake was determined by 24-hour recall or 3-day records. Nutrient intake was compared to the 1974 Recommended Dietary Allowances (RDA); intakes below 67 percent of the RDA were considered low. Correlations of socio-environmental factors with nutrient intake were determined by simple linear regression and multiple regression analysis.

The mean and median of the children's intake of vitamin A, ascorbic acid, thiamin, riboflavin, calcium, protein, and kilocalories

exceeded the RDA. While the median of their niacin intake was just below the RDA, the mean and median of their iron intake was below the recommended level. Protein and riboflavin were consumed abundantly, with 0 and 3.3 percent of the subjects, respectively, failing to receive two-thirds of the RDA. Sixty-three percent of the children ingested diets that supplied two to three times the RDA for protein. The nutrients most commonly lacking were iron, ascorbic acid, calcium and thiamin, with 39.7, 18.7, 15.3, and 13.0 percent, respectively, of the children having low intakes. Forty-one percent of the children received a nutrient supplement, which was not included in these calculations.

The percentage of children consuming diets containing less than 67 percent of the RDA increased with age for the intakes of vitamin A, thiamin, and kilocalories. Low intakes of iron, on the other hand, declined with age. Riboflavin intake was lowest among the four- to six-year-old children. Adequacy of ascorbic acid, niacin and calcium did not show any relation to age.

The socio-environmental variables examined were geographic location (urban, rural, or metropolitan), number of siblings as well as education and occupation of each parent. Other socio-environmental variables considered were whether or not the family received public assistance or had contact with the Cooperative Extension Service personnel and bulletins. When multiple regression analysis was performed, the only significant correlation ($p < 0.05$) was observed between the intake of ascorbic acid, mother's education, and mother's profession. Four socio-environmental variables were significantly correlated ($p < 0.05$) with the intake of one or more nutrients by simple linear regression. A significant correlation was found between mother's education and the intakes of ascorbic acid, calories, and thiamin. A significant correlation was observed between mother's profession and the intakes of niacin and ascorbic acid. Father's education was found to be significantly related to the intake of thiamin. The only significant, negative correlation was found between the intake of thiamin and the number of siblings.

# The Effect of Selected Socio-Environmental Variables on the Dietary Intake of Preschool Children

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## INTRODUCTION

Nutrition during the preschool years is critical because this is a period of considerable growth. Prior to 1970, there were few studies concerned with the nutritional status of preschool children (1-5). Many of these early studies involved small samples of 50 children or less. Only one study (5), performed before 1970, dealt with more than 100 children.

Since 1970, however, the nutriture of preschool children has become a major research interest. Several investigators have focused on children from families of lower socioeconomic levels (6-14); other research has been on children from ethnic groups, such as Mexican-Americans (10, 13) and blacks (9, 11, 12, 14).

Excluding the recent nationwide survey by Owen _et al_. (15), all of the studies performed since World War II have a geographical bias. Six of the investigations were carried out in the South (5, 9, 11-14), five in the Midwest (3, 4, 16-18), and one in the East (2). Of the five studies performed in the West (1, 6-8, 10), none took place in the Northwest.

The preschool child is dependent upon his family for his food. The influences of the child's family on his diet are both direct, as it is the family that must see that his nutritional needs are met, and indirect, for the family also teaches the child attitudes and preferences toward food (19). While the exact effect of the family on the intake of dietary components is not known, several investigators have attempted to determine if such parameters as income and education of the parents, maternal attitude toward various aspects of food, degree of urbanization of the family, and the number in the household are related to the intake of any of the nutrients or calories.

Hendel, Burk, and Lund (20) observed that the education of the mother, the income of the family, and the degree of urbanization of the family all paralleled the intakes of vitamin A and ascorbic acid. In a study performed in the North Central states, Eppright et al. (21) noted that of all the socioeconomic variables analyzed, the amount of money spent for food was the most influential in enhancing the quality of the diet. Two studies have attempted to combine selected socioeconomic variables and assign a status based upon the composite score of the variables. Kerrey et al. (4) reported that among the children in their sample, the intakes of ascorbic acid and vitamin A increased with higher socioeconomic status, while the intakes of thiamin and iron decreased with higher socioeconomic status.

As mentioned previously, no study on the nutritional status of preschool children has been performed recently in the Northwest. The purpose of this thesis is to examine both the dietary intake of

Oregon preschool children, as well as the relationship between dietary intake and selected socio-environmental variables. These variables include: parent's education and occupation, the geographic location of the family (urban, rural, or metropolitan), the number of siblings, exposure to the programs and personnel of the Cooperative Extension Service, and participation in public assistance programs.

# REVIEW OF LITERATURE

Nutritional status, a significant parameter of health in an individual, can be determined by a variety of techniques. Dietary intake data are essential to a nutritional status study, because they reveal both eating patterns, and the quantity and quality of food in the diet (17). Biochemical studies provide valuable information regarding levels of nutrients and their metabolites in body tissues and fluids. Anthropometric data show the extent to which physical development has been affected, positively or negatively, by nutrition. Finally, clinical examination reflects any deviation from health caused by malnutrition (22). Biochemical and clinical abnormalities result only after nutrient reserves have been exhausted (23).

In assessing nutritional status, it is commonly accepted that a combination of several techniques gives more valid information (24). The Expert Committee on Medical Assessment of Nutritional Status of the World Health Organization (WHO) (22) lists ten parameters, as can be seen in Table 1, which together help to arrive at a complete nutritional diagnosis. In addition to those mentioned above, other parameters suggested by this WHO committee include: (a) availability of food, and the factors which influence it; (b) purchasing power, and the distribution of food, both within the family and the community; (c) cultural and anthropological data, and food consumption patterns;

Table 1. Information needed for assessment of nutritional status, from the WHO Report of expert committee on medical assessment of nutritional status (22).

| Sources of information | Nature of information obtained | Nutritional implications |
|---|---|---|
| 1. Agricultural data<br>Food balance sheets | Gross estimates of agricultural production<br>Agricultural methods<br>Soil fertility<br>Predominance of cash crops<br>Overproduction of staples<br>Food imports and exports | Approximate availability of food supplies to a population |
| 2. Socioeconomic data<br>Information on marketing, distribution and storage | Purchasing power<br>Distribution of foodstuffs<br>Storage of foodstuffs | Unequal distribution of available foods between the |
| 3. Food consumption patterns<br>Cultural-anthropological data | Lack of knowledge, erroneous beliefs, prejudices, and indifference | |
| 4. Dietary surveys | Food consumption | Low, excessive, or unbalanced nutrient intake |
| 5. Special studies on food | Biological value of diets<br>Presence of interfering agents<br>Effects of food processing | Special problems related to nutrient utilization |
| 6. Vital and health statistics | Morbidity and mortality data | Extent of risk to community<br>Identification of high risk groups |
| 7. Anthropometric studies | Physical development | Effect of nutrition on physical development |
| 8. Clinical nutritional surveys | Physical signs | Deviation from health due to malnutrition |
| 9. Biochemical studies | Levels of nutrients, metabolites, and other components of body tissues and fluids | Nutrient supplies in the body<br>Impairment of biochemical function |
| 10. Additional medical information | Prevalent disease patterns, including infections and infestation | Interrelationships of state of nutrition and disease |

(d) special studies on local foodstuffs for interfering agents; (e) vital and health statistics, such as morbidity and mortality; and (f) medical information, such as prevalent disease patterns. These parameters demonstrate the many factors which influence nutritional status, either directly or indirectly. Thus, in order to evaluate an individual or a group's nutritional status, the relationships which exist among food intake, nutrient utilization, and total health status must be known (23).

## Obtaining Dietary Information

There are four common methods by which dietary information can be obtained from either groups or individuals; the diet history, the food record or diary, the weighed food record, and the 24-hour recall. Since each method has assets and liabilities, the researcher must decide upon the method most appropriate for the specific data he wishes to obtain (25). Selection of a method is based on: the number of subjects desired, the time period available, the type of data desired, the particular nutrients in question, and the restrictions placed by time and personnel (26).

The first method to be discussed is the dietary history developed by Burke (27). In this technique, the individual describes his daily dietary habits to an interviewer, who records them and questions the subject to obtain additional information on his food intake, which will serve as a cross-check. Once the cross-check has been completed, the nutritionist then ascertains the amount of each food group which is most representative of the subject's average intake. The nutrients are calculated from the subject's intake.

The principal use of the dietary history is in longitudinal research. This technique has the advantage of obtaining the necessary information in the subject's home, where he is at ease and where the household measurements and utensils can be observed (26). The method is costly, however, because it requires a nutritionist skilled in interviewing. The form utilized for the dietary history must be adapted for the particular segment of the population for which it is intended (28). The dietary history also suffers in that the interview will yield only the subjective average of an individual's recalled food intake. Such estimation introduces a large and important source of variation that is difficult to estimate (29).

The food record or diary is another standard method for obtaining dietary information. In this method, the subject utilizes standard household utensils to measure his intake, both at and in-between meals (25).

The weighed food record, a variation of the food diary, is used when more precise information is needed. In this technique, the subject weighs his food intake on a scale. A major criticism of both food records, measured and weighed, is the possible alteration of the subject's eating habits during the course of the diary (28).

The fourth method for acquiring nutrient data from groups or individuals is the recall method, or more commonly, the 24-hour recall. This technique also utilizes a trained interviewer to obtain information regarding a subject's food intake during the past 24-hour period. As would be expected, the intake of only one 24-hour period is not representative of an individual's food habits. However, when many subjects are involved, this technique gives information characteristic of a group (25).

## Sources of Error in Dietary Studies

The sources of error inherent in any dietary study are many and varied. Beginning with the subject himself, a common source of error is the failure to record dietary intake data correctly. This can be achieved either through an inaccurate weighing or measuring in the food diary or record procedures, or via distortion or omission (30).

The nutritionist also introduces a large source of error or variation, as the nutrient values which she derives from the tables of food composition depend upon her interpretation of the measurements reported in the dietaries (31).

Further errors which affect the validity of a study involve the design and actual carrying out of the study. Does the survey sample represent the intended segment of the population? This question is difficult to answer. Also, there comes the almost impossible task of deciding whether the nutrient data derived from the specified time period of the study truly represent the intake of the individual or groups of persons in question (30).

There may be variation in nutrient intake, either from one time period to another, i.e., day to day, week to week, or season to season. Adelson (32) suggests that the extent of variation is a function of the subject, the circumstances, and the season. Trulson (29) believes that variation in food and nutrient intake is related to four factors: food supply, season, socioeconomic factors, as well as religious and cultural patterns. In an earlier study fy Yudkin (33), there was as much as 68 percent variation from week to week, which he attributed to differences in level of activity, errors in weighing, and errors associated with the utilization of food tables.

Hegsted (34) recently discussed variation in dietary survey methods with respect to both the time period and the distribution of the nutrient. Regarding the former, Hegsted explains that with shorter observation periods, both the degree of variation and the prevalence of low intakes will be greater. With respect to distribution, Hegsted argues that a reported low intake of a particular nutrient, such as vitamin A, could well be due to the irregular consumption of foods rich in this nutrient. Yudkin (33) and Adelson (32) reached similar conclusions.

In a report involving the dietary intakes of approximately 100 men, Adelson (32) noted that the largest variation was for ascorbic acid and vitamin A. When comparing the intake of one week to that of the following week, she found that vitamin A showed the greatest dispersion around the mean, while ascorbic acid was the only nutrient studied in which less than one-half of the diets for the first week agreed with those of the second within 20 percent. Eppright (35), in a study involving school children from three Midwestern states, agreed that the intakes of ascorbic acid and vitamin A are more apt to vary than are those of other nutrients.

In a study designed to measure the weekly variation in nutrient intake, Yudkin (33) observed similar degrees of variation for the intakes of protein, fat, carbohydrate, calcium, and iron; the variation for these nutrients was as great as 50 percent, when comparing the intake of one week with that of another week. His conclusion, which was alluded to by Hegsted (34), is that food intake may actually be adequate, while not appearing to be so. Yudkin (33) states: "It is thus possible for a person to have an intake of any of the dietary components which is apparently adequate in one week and inadequate in another."

When food intake data are calculated to determine average amounts of nutrients, surprisingly different results can be obtained, depending upon the person who is calculating, and the table that is used for calculation (31). Additional variation can be introduced if the diets are analyzed chemically and compared with the more common procedure of calculation from a known table. Reporting on more than 300 diets which were both analyzed in a laboratory and calculated from a table of food composition, Whiting and Leverton (36) noted that both calories and protein agreed within ten percent in more than half of the diets, while fat agreed within ten percent in only one-quarter of the cases. The authors explain such differences by suggesting that many commonly listed values describe raw meat obtained from carcass or retail cuts, rather than cooked meat.

## Dietary Intake of Preschool Children

A large percentage of the studies on dietary intake of preschool children have either a regional or an ethnic bias, or both. A few of the studies have dealt with more than 200 subjects. Only two have attempted to include children from more than one state. Another important parameter is the age of the children, as the recommended allowance for a nutrient is a function of the child's age, as well as his weight. Hence, any description of dietary intake should be carefully examined, so that data are reported as being indicative of the sample population only.

Studies involving the dietary intake of preschoolers indicate that caloric intake is generally acceptable (1-4, 6, 8, 10, 11, 13, 18, 37), if one compares either mean or median values for intake with the Recommended Dietary Allowances (RDA). In some studies, however, more than ten percent of the subjects consumed less than either two-thirds (10) or four-fifths (6) of the 1968 RDA for energy. Several studies indicate that calories were inadequately supplied (9, 11, 14). In the Ten-State Nutrition Survey (37), 11.5 percent of the 12- to 23-month-old infants received less than two-thirds of the 1968 RDA for energy, while ten percent of the 24- to 36-month-old toddlers consumed less than three-fifths of the RDA. Owen et al. (15) reported that 9.1 percent of the one- to three-year-old children in their study received less than 61 percent of the 1974 RDA (39) for energy, while 14.6 percent of the four- to six-year-old children ingested less than two-thirds of the same allowance.

Several studies which related satisfactory mean caloric intakes did not report numbers or percentages of children who consumed less than two-thirds of the RDA or other similar standard (13, 16, 17). Low caloric intake is a problem among black and Mexican-American preschool children (6, 9-11, 14).

No other nutrient in the diet of the American preschool child is as well supplied as protein. Of the 19 studies (1-19) focusing on the nutritional status of preschool children since World War II, none shows more than two to three percent of its subjects receiving less than the usual standard of two-thirds of the RDA. Many (6, 7, 10, 11, 13, 15-18) show mean values of intake in excess of 200 percent of the RDA utilized at the time the research was performed. Still others (2, 4) report many of their subjects consuming greater than 100 percent of the RDA, without specifying how much greater. The only study to show a significant proportion (14 percent) of its subjects having low intakes of protein was that done by Futrell, Kilgore, and Windham (14); but, it should be noted that the standard for this study was 1.5 g of protein per kg of body weight, which is approximately 95 percent of the 1974 RDA, not the usual 67 percent or two-thirds.

The intake of thiamin among American preschoolers is generally close to the RDA (2-5, 15, 37, 40). Some investigators have reported between five and ten percent of their subjects receiving less than two-thirds of the RDA (2, 7, 10). Brown _et al_. (8), Owen _et al_. (15), and the Ten-State Nutrition Survey (37) all related that more than ten percent of their subjects had low intakes of thiamin. Owen _et al_. (15) reported that 21 percent of the unsupplemented one- to three-year-old children received less than 70 percent of the 1974 RDA, or 0.49 mg. While Futrell _et al_. (14) also reported that more than ten percent of their subjects had low intakes of thiamin, the standard used by these researchers was 0.4 mg per 1000 calories, or 78 percent of the 1974 RDA.

Intakes of riboflavin by preschoolers are rarely less than the recommended allowance of 0.6 mg per 1000 calories. Many of the studies on dietary intake of preschool children reveal mean intakes of riboflavin in excess of recommended levels (4, 7, 10, 13, 15, 17, 18, 37). While a few studies have reported intakes between 66 and 99 percent of the RDA (2, 4, 15, 17, 18, 37), fewer still have shown intakes below two-thirds of the RDA (5, 15, 18, 37). Although Futrell et al. (14) found nine percent of the preschoolers in their study to have low riboflavin intakes, the standard used in their study was 0.55 mg per 1000 calories, or 92 percent of the 1974 RDA.

Adequate intakes of niacin are usually assured by the more than generous intake of protein consumed by most Americans. Without the conversion of tryptophan to niacin, many preschool children would suffer intakes below acceptable levels (3, 10, 13, 37). When the niacin from tryptophan is included, inadequate consumption of this vitamin is rare. Sims and Morris (18) found that five percent of their sample failed to meet two-thirds of the 1968 RDA for this vitamin.

The intake of ascorbic acid by American preschool children is highly variable, reflecting such factors as the unequal distribution of the vitamin in foods and the season in which the study was performed. If the mean intake were the sole index of adequacy, most, if not all, studies would show more than sufficient intakes (7, 10, 17, 18). The mean intake, however, is generally skewed due to large intakes by only a few children (4, 7, 10, 18).

To what extent is ascorbic acid lacking among preschool children in the United States? Researchers reporting percentages of subjects with dietary intakes below adequate levels range from 10 percent (17), to a high of 51 (37); the standard used for these studies was two-thirds of the 1968 RDA. Using an adequacy level of 37.5 percent of the 1968 RDA, or 15 mg, Owen et al. (5) reported that 19 percent of their sample had less than adequate intakes. Futrell, Kilgore, and Windham (9) noted that 21 percent of their sample failed to ingest adequate amounts of ascorbic acid when this same standard was applied. In recent studies, Owen et al. (15) and Futrell et al. (14) related that 36 and 52 percent of their respective samples had less than adequate intakes of ascorbic acid, when a standard of 30 mg or 75 percent of the 1974 RDA was used.

The intake of vitamin A by American preschool children is also quite variable. Beal (41) and Guthrie (2) both reported acceptable intakes of vitamin A among the preschoolers in their studies. Guthrie found that 93 percent of her subjects ingested more than the 1958 RDA (42); Beal described the 1953 RDA (43) as being above the 25th percentile for only the one- to three- year -old children in her study.

Yet, low intakes of vitamin A have been reported repeatedly. Kerrey et al. (4) showed that 17.5 percent of their sample failed to receive two-thirds of the 1964 RDA (44); Brown et al. (8) found that a similar proportion, 17 percent, had ingested less than that same standard.

All of the above studies have had sample populations of less than 200 subjects. The Ten-State Nutrition Survey (37) examined the dietary intake of approximately 1750 preschoolers; Owen et al. (15) examined twice that figure, or 3500 children. In the former study, the percentage of children with low intakes of vitamin A increased with age, from 4.7 for the 6- to 11-month-old infants, to 18.3 percent for the two-year-old children, despite the fact that the standard for the infants was two-thirds of the 1968 RDA, as compared to 62 percent for the toddlers. Owen et al. (15) indicated that in their study, the percentage of children with low intakes decreased from 19 percent for the one- to three-year-old children to 16 percent for the four- to six-year-old children; these figures apply to unsupplemented children only.

The intake of calcium by American preschoolers appears to be such that, while the majority ingest sufficient levels, there is a small but consistent minority who do not. Inadequate intakes of calcium are common in the South, especially among black children (9, 11, 14).

The mean intake of calcium in several studies is higher than the recommended allowance (4, 7, 10, 17, 18). But, despite acceptable mean intakes of this mineral, some also report small but significant percentages of subjects whose intake is less than adequate, when two-thirds of the 1968 RDA is used as a standard of adequacy (10, 18). In a study of infants in Honolulu, Brown et al. (8) observed that 31 percent of their sample failed to receive two-thirds of the 1968 RDA for calcium.

The Ten-State Nutrition Survey (37) again showed the percentage of children with low calcium intakes increased with age. Of the 340 infants of the 6- to 11-month age group, only 5.6 percent failed to consume more than two-thirds of the 1968 RDA. Yet, of the 708 two-year-old children, 27 percent failed to receive 500 mg, or slightly less than two-thirds of the 1968 RDA. In contrast to the Ten-State Nutrition Survey, Owen et al. (15) observed that 20.3 percent of the one- to three-year-old children, and 14.3 percent of the four- to six-year-old children in their sample ingested less than 62 percent of the 1974 RDA. The latter study, however, included children from four to six years of age, while the former did not.

Several studies on the nutritional status of preschool children have been performed in the South; most, if not all, have indicated that a large percentage of their subjects consumed inadequate amounts of calcium (5, 9, 11, 13, 14). In a 1969 study, Owen et al. (5) noted that 24 percent of their sample failed to receive 400 mg of calcium a day, a standard appreciably less than two-thirds of the 1968 RDA. In a recent study, Futrell et al. (14) reported 44 percent of their sample did not ingest 450 mg a day, which for children four to six years of age is equivalent to 56 percent of the 1974 RDA.

The intake of iron by preschoolers in the U.S. is frequently below the recommended allowance. Iron is unquestionably the nutrient that is lacking more often than any other (2-4, 8, 9, 10, 15, 18, 37, 45, 46). Unlike calcium, the lack of iron is experienced throughout the country.

The principal criterion of dietary adequacy reported in the literature is two-thirds of the RDA. When this standard was used, the percentage of children with inadequate diets varied from 16.1 (18) to 81 (37). The investigators who reported the lowest percentage of children with iron intakes below two-thirds of the 1968 RDA, Sims and Morris (18), dealt with children four to six years of age. Whereas, the study in which 81 percent (applies to children from one to three years of age only) of the sample failed to meet two-thirds of the 1968 RDA, was the Ten-State Nutrition Survey (37), which dealt only with children three years of age and under. Thus, the largest percentage of low iron intakes is usually seen among children less than three years of age, due to the higher requirement for that age group.

Other standards of adequacy have been reported. Johnson and Futrell (12), in a study on five-year-old children, found that 74 percent failed to meet their standard of 8 mg a day, or four-fifths of the 1968 RDA. Owen et al. (15) reported that 77 percent of all unsupplemented one- to three-year-old children failed to receive 9.4 mg a day, or 63 percent of the 1974 RDA. In that same study, 25 percent of the unsupplemented four- to six-year-old children consumed less than 6.4 mg a day, or 64 percent of the 1974 RDA. In a recent study, Futrell et al. (14) observed that 82 percent of their sample failed to meet their criterion of 10 mg a day, equivalent to 100 percent of the 1974 RDA.

## Dietary Intake and Its Relationship to Socio-environmental Variables

The socio-environmental or socioeconomic variables that have been correlated with the nutritional status of preschool children are many and varied. Income and education are among the most common. Some studies have included such parameters as the number in the household, the degree of urbanization of the family, and the influence of public assistance. A recent study by Sims and Morris (18) correlated a child's nutritional status with several variables which comprise the family ecosystem, such as the current family setting, the resources available and their use, and the social-psychological attributes of the mother.

Of all the aforementioned variables, income is without question the one that has been examined most frequently (4, 5, 8, 9, 14, 20, 47). Income is believed by some to have a direct effect upon the food choice and nutritional status of individuals (48, 49). That is, with more money available for food, the quality of the diet improves. Yet, McKenzie (48) relates that as the total income increases, the amount of money spent for food as a proportion of total income decreases. Hence, the amount of money spent for food is also a variable.

The effect of income on the dietary intake of preschool children varies. While two researchers (9, 14) report that there is no consistent effect of income on dietary intake, several indicate effects of income on the intake of specific nutrients (5, 8, 14, 20). In a study of over 300 children, Hendel _et al_. (20) observed that the adequacy of the intakes of ascorbic acid and vitamin A increased with total family income. Owen _et al_. (5) reported that the intakes of calories, protein, and ascorbic acid were significantly lower when the mean of the lowest income group was compared to the composite mean of the highest income groups. In a study of Hawaiian preschoolers, Brown _et al_. (8) related that the mean intakes of calcium, riboflavin, and ascorbic acid were significantly higher among children from middle-income families than children from low-income families.

Futrell _et al_. (9, 14) performed two studies regarding the nutriture of preschool children in Mississippi. In the first, a 1971 study (9), these authors did not report any consistent trend with increasing income; they did note, however, that the highest levels of nutrient intake were for income levels above $750.00 per capita per year. In their more recent study (14), these authors indicated that nutrient intakes did not parallel income. Yet, riboflavin intakes were significantly higher in families with annual per capita incomes of less than $500.00, when families were grouped into those above and below this income figure.

The amount of money spent for food has also been shown to have an effect upon the dietary intake of preschool children. In a study carried out in the North Central states, Eppright et al. (21) noted that of all the socioeconomic variables analyzed, the amount of money spent for food was the most influential in enhancing the quality of the diet. These authors report that the amount of money spent for food influenced the intake of all the energy yielding nutrients, as well as the intakes of calcium, iron, thiamin, riboflavin, and ascorbic acid (21, 46).

Education of the parents, particularly that of the mother, has been correlated with the preschoolers' dietary intake. Hendel et al. (20) reported that the intakes of ascorbic acid and vitamin A increased with the education of the mother. The effect of education was more strongly felt among farm families. Futrell et al. (9) observed that average intakes of calories, protein, calcium, iron, ascorbic acid, and vitamin A all paralleled the education of the mother. The education of the father did not relate to nutrient intake. Futrell et al. (9)

also noted that the children whose mothers had received more than nine years of education had significantly greater intakes of energy and ascorbic acid. Eppright et al. (21) reported that in their study, the intakes of calcium, iron, thiamin, riboflavin, and ascorbic acid increased significantly with the education of the mother. Thus, it appeared that generally, the mothers with more education emphasized the vitamin- and mineral-rich foods, rather than the energy-rich foods.

In a more recent study, Futrell et al. (14) reported the intakes of preschool children in two Mississippi counties. When the education of the mother was compared with nutrient intake for the sample from Noxubee County, it was shown that the average intakes of protein, iron, ascorbic acid, and energy paralleled the education of the mother. The average intakes of iron and calories for children in Noxubee County were significantly higher when the mothers had more than an eighth grade education. In Clay County, only the intake of vitamin A was higher when the mother's education was above the eighth grade. Surprisingly, the average protein and iron intakes in Clay County were higher for children whose mothers received less than a sixth grade education.

Hendel et al. (20) have investigated the effect of the number of offspring on the intakes of ascorbic acid and vitamin A. They observed a consistent trend toward decreasing adequacy of the intakes of these two vitamins with increasing numbers of offspring. This was particularly true for vitamin A.

Eppright _et al._ (21) examined the effect of number in the household upon dietary intake. Their research showed that the number in the household was significantly and positively correlated with the intake of the energy-yielding nutrients, but negatively and significantly correlated with the intake of ascorbic acid. Hence, they suggested that in larger families, more emphasis is placed upon energy-yielding nutrients.

Hendel _et al._ (20) observed that the adequacy of vitamin A and ascorbic acid intakes paralleled the degree of urbanization of the family. The highest percentage of adequate diets in their study was among the urban, high-income group.

Futrell _et al._ (14), who recently investigated the effect of public assistance programs on the dietary intake of preschool children in Mississippi, found no significant difference between those who participated in food programs and those who did not.

Eppright _et al._ (21) examined the effects of maternal attitude toward food and nutrition upon the dietary intake of preschool children. The variables that they investigated were attitudes toward meal planning, food preparation, nutrition, and permissiveness in feeding children, as well as knowledge of nutrition. A significant ($p < 0.01$) positive correlation was observed among each of the following variables: attitude toward nutrition, attitude toward food preparation, attitude toward meal planning, and knowledge of nutrition. A consistently significant negative correlation ($p < 0.01$) was found between permissiveness in feeding children and all other variables. These data as well as the correlations between the four attitudes, knowledge of nutrition and the intake of the 12 dietary components can be seen in Tables 2 and 3.

In 1974, Sims and Morris (18) explored the family environment and its effect upon the child's nutritional status. These researchers divided the family environment into three sections: the current family setting, the resource availability and the social-psychological attributes of the mother. Since the first two have already been discussed, the latter section will be reported here.

As a result of the correlations among the variables of maternal attributes and several characteristics of family environment, Sims and Morris developed two classifications for mothers. The type I mother possessed non-authoritarian attitudes toward child rearing, had low feelings of powerlessness, and believed strongly in family centrism, freedom, and education. For the type I mother, nutrition was important, and knowledge of nutrition was greater than among the mothers classified as type II. Least important values for type I mothers were prestige and religion. Sims and Morris noted that

Table 2. Simple linear correlations (r's) among attitudes toward food and nutrition and nutrition knowledge for sample of mothers of preschool children (from Eppright et al., 21).

| | Nutrition knowledge | Meal planning | Attitudes toward food preparation | Permissiveness | Nutrition |
|---|---|---|---|---|---|
| Knowledge | | .378* | .075* | -.364* | .586* |
| Meal planning | .378* | | .260* | -.257* | .390* |
| Food preparation | .075* | .260* | | -.040 | .170* |
| Permissiveness | -.364* | -.257* | -.040 | | -.403* |
| Nutrition | .586* | .390 | .170* | -.403* | |

*Significant at the ($p < 0.01$) level.

Table 3. Simple linear correlations (r's) among mothers' attitudes toward food and nutrition, nutrition knowledge, and the mean daily intake of food energy and nutrients of preschool children (from Eppright et al., 21).

| Dietary component | Nutrition knowledge | Attitudes toward: Meal planning | Food preparation | Permissiveness | Nutrition |
|---|---|---|---|---|---|
| Calories | .058* | .079* | .064* | -.061* | .047 |
| Protein | .077* | .067* | .090* | -.089* | .067* |
| Fat | .047 | .042 | .065* | -.041 | .034 |
| Carbohydrate | .051 | .098* | .041 | -.059* | .043* |
| Calcium | .062* | .053 | .077* | -.092* | .048 |
| Phosphorus | .082* | .073* | .074* | -.114* | .068* |
| Iron | .047 | .094* | .030 | -.092* | .034 |
| Vitamin A | .025 | .012 | .028 | -.104* | -.011 |
| Thiamin | .028 | .070* | .028 | -.078* | .023 |
| Riboflavin | .069* | .064* | .090* | -.114* | .050 |
| Niacin | .085* | .079* | .078* | -.094* | .068* |
| Ascorbic acid | .107* | .091* | .014 | -.059* | .053 |

*Significant at the ($p < 0.01$) level.

children of type I mothers tended to have higher intakes of calcium and ascorbic acid.

Type II mothers, in direct contrast to type I mothers, held authoritarian attitudes toward child rearing, experienced a greater sense of powerlessness, and had lower self-concepts as mothers. Type II mothers did not agree with the "nutrition is important" attitude and obtained lower scores on a test of nutrition knowledge. For type II mothers, prestige and religion were quite important, while education was not. In contrast to children of type I mothers, children of type II mothers had higher intakes of calories, carbohydrate, iron, and thiamin. Sims and Morris deduced that this was due to increased consumption of enriched bread and cereal products.

In a 1968 study, Kerrey et al. (4) reported the intakes of children of both high and low socioeconomic status. The group of children of high socioeconomic status attended a university child development laboratory, while the children of low socioeconomic status received public assistance. The authors reported that the children with higher status had higher intakes of ascorbic acid and vitamin A, while the children of lower status received significantly more iron and thiamin.

Owen et al. (15) described the dietary intakes of 3500 children who were divided into groups according to an index of socioeconomic status known as Warner Rank (WR). Warner Rank was determined by adding scores from one (very high status value) to seven (very low status value) for the following variables: occupation, source of income, dwelling type, and dwelling area. WR I represents the lower segment of the lower class; WR II the upper, lower class; WR III the lower, middle class; WR IV the upper, middle class; and WR V, the upper class.

Owen et al. (15) reported little difference among children in the various Warner Ranks with respect to average nutritive quality of the diet, when nutrient intakes per 1000 calories were compared. The percentage of children with low intakes, however, did vary considerably from one Warner Rank to another. The intakes of the following dietary components increased with Warner Rank: energy for both the one- to three-, and the four- to six-year-old children; thiamin, for the one- to three-year-old children; ascorbic acid, for both age groups; vitamin A, for both age groups; and calcium, for both the one- to three- and the four- to six-year-old children. The intakes of riboflavin for both age groups, and the intake of thiamin for the four- to six-year-old children were appreciably greater in the three higher Warner Ranks. In contrast, the greatest percentage of low iron intakes occurred among the children in Warner Rank IV.

# PROCEDURE

## Description of Study Population

This study is a part of a larger investigation entitled Nutritional Health, Food Intake, and Socio-Environmental Profiles in Oregon Preschool Children. This investigation included biochemical analysis of venous blood samples, clinical and anthropometric data recorded during physical examinations, socio-environmental data, as well as information regarding dietary intake. Reported in this thesis are dietary and socio-environmental data; the biochemical, clinical, and anthropometric data are reported elsewhere.

Participating in the study were 300 boys and girls ranging in age from 8 to 99 months. The distribution of the children's ages can be seen below.

| Age (months) | Percent |
|---|---|
| $< 12$ | 1.3 |
| 13-24 | 3.7 |
| 25-36 | 11.3 |
| 37-48 | 17.0 |
| 49-60 | 16.7 |
| 61-72 | 28.3 |
| $> 72$ | 21.6 |

The subjects attended either Well Child or Multiphasic Screening Clinics which were organized by the individual counties with assistance from both the State Health Division and the Cooperative Extension Service.

The children were drawn from 11 of Oregon's 36 counties: Benton, Hood River, Curry, Marion, Polk, Multnomah, Harney, Morrow, Columbia, Klamath, and Lincoln (Figure 1). Of the 11 counties, six were predominantly rural, four were urban, and one was metropolitan (Table 4) (50). The 11 counties are representative of the variety of climates, altitudes, and populations which exist within the state of Oregon. Table 4 includes data regarding the number of children from each of the 11 counties, and the month and year in which each of the counties was sampled.

The number of siblings for the 300 children in the sample ranged from none to six, as given below.

| Siblings | Percent |
|---|---|
| 0 | 13.0 |
| 1 | 36.0 |
| 2 | 27.0 |
| 3 | 10.7 |
| 4 | 9.3 |
| 5 | 2.7 |
| 6 | 1.3 |

Seventy-six percent of the children had less than or equal to two siblings. Of the 300 children in the sample, 39 percent were siblings.

The educational level of the children's parents varied considerably. Most of the parents completed high school. The fathers of the children received more education than the mothers, as Table 5 indicates.

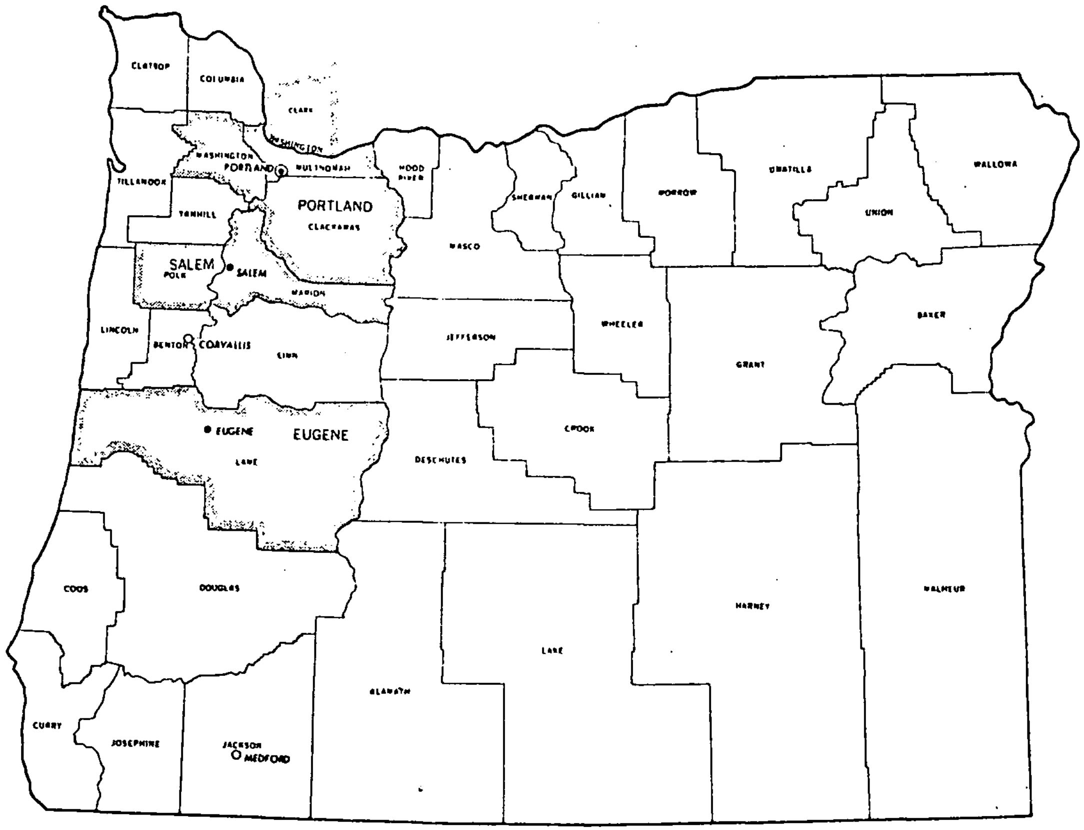


Figure 1. Map of the state of Oregon, showing counties involved in the study (50).

Table 4. Number of children from each county and time of sampling for each county.

| County | Number of children | Time of sampling |
|---|---|---|
| Benton (U)[1] | 39 | January 1973 |
| Hood River (R)[2] | 20 | August 1973 |
| Curry (R) | 10 | October 1973 |
| Marion (U) | 32 | October 1973 |
| Polk (U) | 39 | November 1973 |
| Multnomah (M)[3] | 51 | June 1974 |
| Harney (R) | 21 | July 1974 |
| Morrow (R) | 33 | August 1974 |
| Columbia (R) | 12 | August 1974 |
| Klamath (U) | 31 | February 1975 |
| Lincoln (R) | 12 | April 1975 |

[1] U = urban

[2] R = rural

[3] M = metropolitan

Table 5. Level of the parents' education.[1]

| Level of education | Percent of mothers | Percent of fathers |
|---|---|---|
| <8th grade | 1.7 | 2.0 |
| <High school | 13.3 | 13.6 |
| High school | 57.3 | 43.3 |
| B.S. | 10.7 | 6.3 |
| M.S. | 0.3 | 6.3 |
| Ph.D. | 0.0 | 2.7 |

[1]No level of education was obtained for 16.7 percent of the mothers and 41.4 percent of the fathers.

Table 6. Occupational scores of the parents.

| Score | Percent of mothers | Percent of fathers |
|---|---|---|
| 0[a] | 63.6 | 20.0 |
| 0[b, c] | 4.0 | 10.0 |
| 10 | 3.7 | 15.7 |
| 20 | 4.0 | 1.3 |
| 30 | 3.7 | 7.0 |
| 40 | 0.7 | 7.0 |
| 50 | 1.0 | 7.3 |
| 60 | 1.3 | 9.0 |
| 70 | 8.3 | 7.0 |
| 80 | 8.7 | 7.7 |
| 90 | 1.0 | 8.3 |

[a]Percent of mothers and fathers for whom no data were obtained, or, in the case of mothers, those who were homemakers.

[b]Percent of mothers and fathers who held jobs of low status.

[c]All occupational scores of zero were grouped together and run as a single number.

The occupations of both parents were given status scores based upon a classification system developed by Charles Nam (51) from data of the 1960 census. These scores were based upon average levels of income and education for males. Within this classification system, there are nine categories: professional, technical and kindred; operatives and kindred workers; managers, officials, and proprietors except farm; clerical and kindred workers; sales workers; craftsmen, foremen, and kindred; private household workers; service workers, except private household; and laborers. This classification system awards numerical scores from 99 to 0 for the various professions. In this study, the scores were divided into ten groups, ranging from 90 to 0, to facilitate statistical analysis (Table 6).[1] In Table 6 a score of zero may indicate that data were unobtainable, or that the occupation was of low status.

## Selection of Study Population

No fixed criteria were used for the selection of children in the sample, other than a willingness to participate on the part of both the mothers and the children. Some of the families involved in the study were contacted by visit, telephone, or letter prior to the date of the clinic, while others were asked to participate at the clinic. Contacts

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[1] A more complete explanation as to how the scores were assigned to the various occupations can be found in Appendix 2.

by letter, telephone, or visit were made by personnel of the State Health Division or the Cooperative Extension Service at the county level.

## Interview Procedure

The subject's parent or guardian, usually the mother, was interviewed to obtain the necessary dietary and socio-environmental information. In eight of the counties in the study, dietary information for each child was obtained from three-day food records; these were distributed to the parents prior to the date of the clinic by the county agency or agencies responsible for the clinic. Dietary data from the three remaining clinics were obtained through the use of a 24-hour recall. The form used during the 24-hour recall can be found in Appendix 3.

A parent or guardian of each subject was interviewed by a home economist employed by the Department of Foods and Nutrition at Oregon State University. During the interview a food frequency chart (Appendix 3) was completed for each child. If the mother had not completed a three-day food record for each child prior to the interview, a 24-hour recall was also performed. The food frequency chart served as a cross-check. If the dietary record or recall were appreciably different from the food frequency chart, the child was not included in the study.

## Treatment of Data

Dietary intake data were coded according to a table of food composition developed by The Ohio State University (52); the dietary data were keypunched and then tabulated by computer for their nutrient content. The intake of energy, protein, calcium, iron, thiamin, riboflavin, niacin (preformed), ascorbic acid, and vitamin A for each child was calculated in the appropriate unit and as a percentage of the 1974 RDA (39). Mean and median intake values were calculated for the entire sample. An intake of any of the eight nutrients or calories that was less than 67 percent of the 1974 RDA was considered "low." The percentage of children with low intakes of the eight nutrients and calories was calculated for the entire sample and for the following age groups: less than 12 months, 13 to 47 months, 48 to 83 months, and more than 83 months.

Forty-one percent of the children in the sample were receiving a nutrient supplement on a regular basis. These supplements were not included in the calculation of dietary intake.

Several socio-environmental variables were correlated with the dietary intake of the eight nutrients and calories. These parameters were: geographic location (urban, rural, or metropolitan), the number of siblings, participation in public assistance programs, exposure to the Cooperative Extension Service, years of education completed by each parent, and occupational status of each parent. The nutrients with which the above mentioned variables were correlated were noted previously. Correlations were obtained by both simple linear regression and multiple regression analysis. The method used for the multiple regression analysis was the stepwise procedure, in which the independent variable with the highest "t" value is added first (53). The remaining variables are added in similar fashion.

## Experimental Approval

This investigation was submitted to the Human Subject's Committee by Ms. Eva Benson, and was approved on March 23, 1973. A parental permission form was signed by a parent or guardian of each subject.

# RESULTS AND DISCUSSION

## Dietary Intake

The nutrient intake of the children, listed as a percentage of the 1974 RDA (39), is reported in Table 7. Central tendency was calculted by the mean and the median, to demonstrate any skewing of the mean by either high or low intakes of the nutrients and calories. The 25th and 75th percentiles for each of the eight nutrients and calories were also calculated as another means of showing the general trend for the intake of each nutrient.

The mean intakes of all the nutrients and calories, except iron, were in excess of the 1974 RDA. While the median intakes were slightly below the mean intakes, only the median intakes of iron (74.0 percent), and niacin (98 percent) were below the 1974 RDA. Thus, the overall quality of the children's diets was good. Of the eight nutrients and calories, only six had 25th percentile values below the 1974 RDA (Table 7). As only preformed niacin was calculated, the low 25th percentile value for this vitamin is not considered significant. But, the remaining four nutrients and calories (calories, thiamin, ascorbic acid, calcium, and iron) for which the 25th percentile figures were below the 1974 RDA are precisely which nutrients were most commonly lacking by the children in the sample.

Table 7. Nutrient intakes of the sample population as a percentage of the 1974 RDA.

| Nutrient | Mean ± S.D. | Median | 25th Percentile | 75th Percentile |
|---|---|---|---|---|
| Calories | 105 ± 32 | 101.0 | 81.5 | 123 |
| Protein | 233 ± 81 | 225.0 | 178.0 | 277 |
| Thiamin | 113 ± 52 | 103.0 | 81.0 | 135 |
| Riboflavin | 185 ± 79 | 178.0 | 129.0 | 228 |
| Niacin[1] | 103 ± 44 | 97.5 | 70.0 | 127 |
| Ascorbic acid | 209 ± 176 | 162.0 | 83.0 | 284 |
| Vitamin A | 191 ± 137 | 155.0 | 103.0 | 238 |
| Calcium | 129 ± 64 | 119.0 | 88.0 | 160 |
| Iron | 85 ± 44 | 74.0 | 55.0 | 102 |

[1]Calculated using mg of preformed niacin only.

As mentioned previously, 39 percent of the subjects in the study population were siblings. As would be expected, most diets of siblings were similar as to food components, with the major variation being in the amount consumed. Thus, with such a large percentage of siblings in the sample, the normal variation introduced by different individuals was reduced.

The caloric intake of the study population was slightly above recommended values, as demonstrated by the mean and median figures which were 105 and 101 percent of the 1974 RDA, respectively. Dierks and Morse (3) and Kerrey et al. (4), Crumrine and Fryer (17), Burroughs and Huenemann (6), the Ten-State Nutrition Survey (37), Sims and Morris (18), and Acosta et al. (10) all reported an acceptable mean or median intake of calories. Fryer et al. (16) observed that in their sample of 3500 children, the median was generally above the 1968 RDA (38). In a recent nationwide survey, Owen et al. (15) noted that the 1974 RDA was just below the mean caloric intake of the one- to three-year-old children, and slightly above the mean intake for the four- to six-year-old children.

Despite acceptable mean and median caloric intakes, 10.3 percent of the children failed to receive two-thirds of the 1974 RDA for calories (Table 8). This percentage is similar to that in research reported by Acosta et al. (10), who observed that 12 percent of their sample ingested less than two-thirds of the 1968 RDA. Earlier

Table 8. Percentage of children with low nutrient intakes (67% of the 1974 RDA).

| Nutrient | Age (mo.) < 12 (n=4) | 12-47 (n=96) | 48-83 (n=184) | > 83 (n=16) | Total (n=300) |
|---|---|---|---|---|---|
| Calories | 0 | 4.2 | 11.4 | 37.5 | 10.3 |
| Protein | 0 | 0 | 0 | 0 | 0 |
| Thiamine | 0 | 7.3 | 14.1 | 37.5 | 13.0 |
| Riboflavin | 0 | 1.0 | 4.9 | 0 | 3.3 |
| Niacin | 25.0 | 17.7 | 20.1 | 43.8 | 20.7 |
| Vitamin C | 25.0 | 22.9 | 15.2 | 31.3 | 18.7 |
| Vitamin A | 0 | 4.2 | 10.9 | 18.8 | 9.0 |
| Calcium | 0 | 15.6 | 18.8 | 12.5 | 15.3 |
| Iron | 50.0 | 66.7 | 27.7 | 12.5 | 39.7 |

research reported by Kerrey et al. (4) showed that 7.5 percent of their sample failed to receive two-thirds of the 1964 RDA (44). On the other hand, Sims and Morris (18) reported that less than one percent of their sample did not meet two-thirds of the 1968 RDA for calories. It should be noted that the RDA for calories has increased since 1964.

As Table 8 indicates, the percentage of children who failed to meet two-thirds of the 1974 RDA for calories increased with age. While the number of children who are either younger than one year or older than six years is small in the present study, the increase in low caloric intake in children from one to three years, to four to six years is substantial. In a recent nationwide study, Owen et al. (15) observed that 9.1 percent of the one- to three-year-old, and 14.6 percent of the four- to six-year-old children received less than 61 and 67 percent of the 1974 RDA, respectively. Acosta et al. (10) did not show any consistent effect of age upon the intakes of energy.

The intake of protein by the preschool children in our sample was high, as shown by mean and median intakes of 233 and 225 percent of the 1974 RDA, respectively. High intakes of protein have been reported in other studies. Owen et al. (15), Burroughs and Huenemann (6), Ho and Brown (7), Fryer et al. (16), Acosta et al. (10), Larson et al. (13), and Sims and Morris (18) each reported mean protein intakes in excess of 200 percent of the RDA which was current at the time their investigations were performed. Crumrine and Fryer (17) and Driskell and Price (11) both observed mean protein intakes of approximately 190 percent of the 1968 RDA. Yet, mean protein intakes below 125 percent of the 1968 RDA have been reported by Brown et al. (8). A few researchers (2-4) have reported protein intakes in excess of the RDA, without specifying how much in excess these intakes were.

Among the 300 children in the sample, no child had an intake of protein below 67 percent of the 1974 RDA. Several researchers (2, 3, 7, 8, 10, 17, 18) have also reported few, if any, intakes below two-thirds of the allowance for protein. In their pilot study performed in Mississippi (5), Owen et al. observed that four percent of their sample received less than 1.5 g of protein per kg of body weight, but how much below was not specified. The Ten-State Nutrition Survey (37) reported less than four percent of the one- to three-year-old children as having intake below 75 percent of the 1968 RDA. In their recent nationwide study, Owen et al. (15) noted that less than one percent of the one- to three-year-old and four- to six-year-old chilren failed to meet 77 and 67 percent of the 1974 RDA for protein, respectively.

The intake of thiamin by the preschool children in our sample was close to the 1974 RDA. These findings are similar to those obtained by Beal (40), and Brown et al. (8). Kerrey et al. (4) and

Larson et al. (13) have reported mean intakes of thiamin appreciably higher than the RDA. In three studies performed in Mississippi by Futrell et al. (9, 14) and Owen et al. (5), mean thiamin intakes were similar to recommended levels, due to a state enrichment law requiring the enrichment of breads and cereals. The mean thiamin intake for the 300 children in the sample was also close to the 1974 RDA, again due to a state enrichment law.

Despite an adequate mean intake, 13 percent of the children in the sample failed to receive two-thirds of the 1974 RDA for thiamin. Low intakes of this vitamin by the children in this study may reflect a general poor food intake. Previous studies by Guthrie (2) and Ho and Brown (7) reported between five and ten percent of their subjects having intakes of thiamin below two-thirds of the recommended level. In a study performed in Honolulu, Brown et al. (8) noted that 19 percent of their sample failed to meet two-thirds of the 1968 RDA. As with energy intake, the percentage of children who failed to receive adequate amounts of thiamin increased with age. These results are in contrast to those of Owen et al. (15), who reported a decrease of low intakes with age. Acosta et al. (10) did not note any consistent effect of age upon the intake of this vitamin.

Riboflavin was among the more well supplied nutrients for the children in the sample. The mean and median intake were close to 180 percent of the 1974 RDA. Crumrine and Fryer (17), Brown et al.

(8), and Beal (40) also observed mean intakes between 150 and 200 percent of the allowance for riboflavin. Several investigators (10, 13, 18) have reported mean riboflavin intakes in excess of 200 percent of the 1968 RDA. The lower mean intake reported in this study may reflect the increased allowance for this vitamin in the 1974 RDA.

Only 3.3 percent of the children in our sample failed to receive two-thirds of the 1974 RDA for riboflavin. These results are similar to those of Brown et al. (8) and Owen et al. (5), who noted that five and three percent of their respective sample populations received less than two-thirds of the 1968 RDA. Guthrie (2), Dierks and Morse (3), and Sims and Morris (18) each reported that no child in their investigations received less than two-thirds of the allowance for riboflavin. In this investigation, the largest percentage of low intakes, 4.9 percent, occurred among four- to six-year-old children; one percent of all other age groups in the sample had low intakes of this vitamin. Owen et al. (15) also noted an increase in the percentage of low intakes of riboflavin with age.

Both mean and median intakes of preformed niacin by the children in this investigation approximated recommended levels (Table 7). Brown et al. (8) and Acosta et al. (10) both reported mean intakes of preformed niacin that were slightly below the 1968 RDA. Crumrine and Fryer (17) mentioned that in their study, the intake of preformed niacin was 170 percent of the 1968 RDA. Ho and Brown (7) and Sims and Morse (18) observed mean intakes of greater than 200 percent of the 1968 RDA for niacin when the niacin from the tryptophan conversion was included.

Over 20 percent of the sample failed to consume adequate amounts of preformed niacin, when two-thirds of the 1974 RDA is used as a criterion of adequacy (Table 8). Dierks and Morse (3) and Brown et al. (8) each reported intakes of preformed niacin that were below recommended levels. Due to large intakes of protein by the children in the sample, however, the niacin derived from the tryptophan conversion alone is greater than two-thirds of the 1974 RDA, when the median protein intake (Table 8) is used as a basis for calculation. Beal (40) and Acosta et al. (10) assumed adequate intakes of niacin due to the generous intake of protein by their sample populations.

If either the mean or median intake were the sole standard of adequacy, the intake of ascorbic acid by the children in this investigation would indeed be adequate. The mean intake was 209 percent of the 1974 RDA, while the median was 162 percent, demonstrating that the mean was skewed in the direction of high intakes. Other investigators (4, 8, 10, 18) have also observed this. Burroughs and Huenemann (6), Crumrine and Fryer (17), Driskell and Price (11), and Larson et al. (13) all reported mean ascorbic acid intakes close to 200 percent of the 1968 RDA.

Approximately 20 percent of the children in this investigation failed to receive two-thirds of the RDA for ascorbic acid. Guthrie (2) and Sims and Morris (18) each reported that 13 percent of their sample populations had intakes of this vitamin which were below two-thirds of the RDA. Kerrey et al. (4) noted that 27.5 percent of their sample did not meet two-thirds of the 1964 RDA for ascorbic acid, which was higher than the current 1974 RDA for this vitamin. Ho and Brown (7), Brown et al. (8) and Acosta et al. (10) reported that 25, 34.5, and 29 percent of their respective sample populations failed to meet two-thirds of the 1968 RDA for ascorbic acid. The smaller percentage of low intakes among the children in this investigation may reflect the fact that five of the counties, whose children constitute 45 percent of the study population, were sampled in the summer, when fresh fruits and vegetables are in abundance. The larger percentage of low intakes reported by Kerrey et al. (4) may be due to the higher allowance for ascorbic acid in the 1964 RDA. There was no consistent effect of age upon the percentage of children with low intakes of this vitamin.

The intake of vitamin A by the preschool children in this study was high, as judged by a mean of 191 and a median of 155 percent of the 1974 RDA. Kerrey et al. (4), Crumrine and Fryer (17), Burroughs and Huenemann (6), and Driskell and Price (11) each observed mean intakes of vitamin A which were greater than or equal to 150 percent of the 1968 RDA for their sample populations. The Ten-State Nutrition Survey (37) also showed considerable variation between mean and median intakes of vitamin A, presumably due to large intakes of this vitamin by a few children. As can be seen in Table 7, the difference between the mean and the median is greater for vitamin A than for vitamin C; it is assumed that this disparity is due to the irregular distribution of vitamin A in foods, as was discussed earlier.

Less than ten percent of the subjects in the present study failed to meet two-thirds of the 1974 RDA for vitamin A. Ho and Brown (7) and Acosta et al. (10) reported that six and seven percent of their sample populations, respectively, failed to meet two-thirds of the 1968 RDA for vitamin A. Kerrey et al. (4) and Brown et al. (8) each noted that 17 percent of their sample populations ingested less than two-thirds of the RDA. In their recent nationwide survey, Owen et al. (15) observed that 19 percent of the one- to three-year-old children received less than 75 percent of the 1974 RDA for vitamin A, while 16 percent of the four- to six-year-old children received less than 60 percent. A possible explanation for the small number of children with low intakes of vitamin A in this study is that all but three of the counties were sampled in the summer or fall, seasons in which the availibility and consumption of fresh fruits and vegetables are greater. The percentage of sample children with low intakes of vitamin A increased with age. This was not observed by Acosta et al. (10).

Both the mean and median intake of calcium by the children in this study were greater than the 1974 RDA. Kerrey et al. (4), Crumrine and Fryer (17), Fox et al. (46), Ho and Brown (7), Owen et al. (15), and Sims and Morris (18) reported either mean or median intakes of calcium that were greater than or equal to the recommended allowance. While Driskell and Price (11) and Larson et al. (13) both observed mean calcium intakes below the 1968 RDA, it should be noted that both these studies dealt with ethnic groups.

Many studies indicate that there is a small but consistent minority who do not receive adequate amounts of calcium (2, 4, 10, 15, 18, 37). In the present sample of 300 children, 15.3 percent of the children failed to receive two-thirds of the 1974 RDA for calcium. Guthrie (2) and Kerrey et al. (4) both reported that between five and ten percent of their sample populations did not meet two-thirds of the RDA. Acosta et al. (10) and Brown et al. (8) observed that 11 and 31 percent of their respective sample populations failed to consume at least two-thirds of the 1968 RDA. Owen et al. (5) noted that among the preschool children in their sample, 24 percent failed to ingest greater than or equal to 400 mg of calcium per day, an amount equivalent to 50 percent of the 1968 RDA. In their recent nationwide study, Owen _et al._ (15) reported that 20 percent of the one- to three-year-old children and 14 percent of the four- to six-year-old children failed to meet 62 percent of the 1974 RDA. There was no consistent effect of age upon the intakes of this mineral.

The mean and median intakes of iron by the children in this study were below recommended levels. This is consistent with research reported by several investigators (8, 11, 17). Kerrey _et al._ (4) and Sims and Morris (18) also noted that in their studies, iron was the only nutrient the mean intake of which was below recommended levels.

The dietary intake of iron among the 300 children in the sample was low, as approximately 40 percent had intakes below two-thirds of the 1974 RDA (Table 8). Guthrie (2), Kerrey _et al._ (4), and Acosta _et al._ (10) reported that 27.5, 37.5, and 44 percent of their respective sample populations failed to meet two-thirds of the RDA for this mineral. Percentages of children failing to meet two-thirds of the RDA for iron in other studies have ranged from 16 (18) to 81 (37). It should be noted that the investigators who reported the lowest percentage of children with iron intakes below two-thirds of the 1968 RDA, namely Sims and Morris (18), dealt with children four to six years of age. Whereas the study in which 81 percent of the sample (one- to three-year-old children only) failed to meet two-thirds of the 1968 RDA was the Ten-State Nutrition Study (37), which dealt with children from six months of age to three years, an age group for whom the recommended allowance is much higher. In the present study, the highest percentage of low intakes of iron was also found among the one- to three-year-old children. Thus, when the percentage of children with inadequate intakes of iron is reported, the age of the children must be considered.

The percentage of children in this study with low iron intakes rose from 50 for infants 12 months and under to 67 for children from one to three years of age; the percentage of children four to six years of age and those older than six years with low iron intakes was 27.7 and 12.5, respectively. It must be noted, however, that the number of children in the sample under 12 months of age is small. Yet, in the Ten-State Nutrition Survey (37), the percentage of children with intakes below 67.5 percent of the 1968 RDA rose from 64 for the 6- to 11-month-old infants, to 81 for the one- to three-year-old children. Acosta et al. (10) noted that 86 percent of the one- to three-year-old children in their sample failed to receive two-thirds of the 1968 RDA. Owen et al. (15) observed that 77 percent of the one- to three-year-old children and 25 percent of the four- to six-year-old children received less than 64 percent of the 1974 RDA for iron.

## Correlations between the Nutrients

Table 9 presents the simple linear correlation coefficients between the eight nutrients and calories. Due to the large number of subjects, all but three of the correlation coefficients were significant. In this study, however, only correlation coefficients greater than or equal to .6 have been arbitrarily labeled meaningful.

The nutrient most highly correlated with calories was protein, with a correlation coefficient (r) of .760. This is expected, due to the high intake of protein by the children in this study.

The two highest correlation coefficients, .848 and .796, were observed respectively between calcium and riboflavin, and riboflavin and protein. A similar high correlation, .713, was found between calcium and protein. A major source of protein for the children was milk, which is also the chief source of riboflavin and calcium in the American diet. Other major sources of protein consumed by the children were meat, poultry, and eggs. Of the 300 children, only one was a true vegetarian, in that she consumed no animal products.

No nutrient was highly correlated with thiamin, the highest correlation being between thiamin and riboflavin. The correlation coefficient for thiamin and calories was .503. Among the 300 children in the sample, few received large amounts of this vitamin. The most common sources of this vitamin in the dietaries were legumes, whole grain, and enriched bread and cereal products.

Table 9. Simple linear correlation coefficients between dietary components.

| | Calories | Protein | Thiamin | Ribo-flavin | Niacin | Vitamin A | Ascorbic | Calcium | Iron |
|---|---|---|---|---|---|---|---|---|---|
| Calories | | .760[b] | .503 | .607 | .559 | .192 | .172 | .469 | .266 |
| Protein | .760 | | .494 | .796 | .664 | .180 | .105*[a] | .713 | .350 |
| Thiamin | .503 | .494 | | .541 | .429 | .236 | .263 | .320 | .464 |
| Riboflavin | .607 | .796 | .541 | | .491 | .325 | .080* | .848 | .313 |
| Niacin | .559 | .664 | .429 | .491 | | .247 | .135* | .307 | .335 |
| Vitamin A | .192 | .180 | .236 | .325 | .247 | | .336 | .149 | .235 |
| Ascorbic acid | .172 | .105* | .263 | .080* | .135* | .336 | | .148 | .200 |
| Calcium | .469 | .713 | .320 | .848 | .307 | .149 | .148 | | .308 |
| Iron | .266 | .350 | .464 | .313 | .335 | .235 | .200 | .308 | |

[a] Due to the large number of children in the sample, all but those correlation coefficients marked with an asterisk were significant ($p < 0.01$).

[b] In this study, only correlation coefficients greater than or equal to .6 have been arbitrarily labeled meaningful.

The nutrient most highly correlated with niacin was protein (r = .664). Since the major sources of this vitamin (liver, lean meats, whole grains, and nuts) are also high in protein, this is to be expected. The most common sources of niacin and its precursor, tryptophan, for the study population were lean meats, nuts, as well as whole grain and enriched bread and cereal products.

As can be seen in Table 9, no nutrient was highly correlated with either vitamin A or ascorbic acid, but the two were correlated with each other. Many of the children in the sample consumed large amounts of "Tang"[2] and other fortified breakfast drinks, most of which are fortified with both vitamin A and ascorbic acid. The percentage of the USRDA[3] for ascorbic acid supplied by these drinks is greater than that supplied for vitamin A. The skewing of the mean in the direction of high intakes was due chiefly to the consumption of such products. Common sources from which the children obtained vitamin A included squash, carrots, liver, fortified breakfast drinks, tomatoes, green vegetables, and fresh fruit. Major sources of ascorbic acid for the children were citrus products, fortified breakfast drinks, green vegetables, and fresh fruit.

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[2] Manufactured by General Foods, Inc.

[3] United States Recommended Dietary Allowances, used for nutrition labeling.

None of the other seven nutrients or calories was highly correlated with iron. The highest correlation coefficient, .464, was noted between thiamin and iron. Common sources of iron among the population studied were meats, legumes, whole grain, and enriched bread and cereal products.

## Dietary Intake and Socio-environmental Variables

Among the socio-environmental variables that were related to dietary intake, only four were found to be significantly correlated with the intake of one or more nutrients or calories by simple linear regression (Table 10). When multiple regression analysis was performed, the only significant correlation ($p < 0.05$)[4] was observed between the intake of ascorbic acid, education of the mother, and occupational status of the mother. Hendel et al. (20) and Futrell et al. (9) similarly reported that the intake of ascorbic acid paralleled the education of the mother.

The education of the mother was significantly correlated with the intake of ascorbic acid, thiamin, and calories. As mentioned previously, Hendel et al. (20) and Futrell et al. (9) both noted a positive correlation between education of mother and the intake of ascorbic acid. In two separate studies performed by Futrell et al. (9, 14), a

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[4] All significant variables can be assumed to have a significance of ($p < 0.05$) or higher.

Table 10. Correlation coefficients between dietary intake and selected socio-environmental variables.

| Socio-environmental variable | Nutrient | Correlation coefficients | Significance |
|---|---|---|---|
| Mother's education[1] | Ascorbic acid | r = .175 | p = .002 |
| | Calories | r = .126 | p = .029 |
| | Thiamin | r = .119 | p = .039 |
| | Niacin | r = .111 | p = .055 |
| Mother's profession | Niacin | r = .235 | p = .00004 |
| | Ascorbic acid | r = .153 | p = .008 |
| | Protein | r = .110 | p = .058 |
| | Calories | r = .107 | p = .064 |
| Father's education | Thiamin | r = .117 | p = .043 |
| | Ascorbic acid | r = .103 | p = .076 |
| Number of siblings | Thiamin | r = -.156 | p = .007 |

[1]Only those socio-environmental parameters that were related to the intake of a nutrient or calories at a significance level of ($p < 0.10$) are listed here. No significant correlation was observed between the intake of any nutrient or calories and the following variables: father's profession, geographic location, exposure to the personnel or publications of the Cooperative Extension Service, and participation in public assistance programs.

significant, positive correlation was observed between caloric intake and the education of the mother. Eppright et al. (21) also found that among the children in their sample, the intake of calories paralleled the education of the mother. It is possible that with more education, mothers learn to provide both the energy-yielding nutrients and the vitamins and other micronutrients.

While the variables of parent's education and their occupational status score were separated in the present study, there is a definite relationship between the two. Another parameter commonly associated with both education and profession is income. Since income data were not obtained, this variable could not be included in this investigation.

A significant, positive correlation was found between mother's profession and the intake of niacin and ascorbic acid (Table 10). As can be seen in Table 6, however, the distribution of the mothers' occupational score was irregular. Almost 70 percent of the mothers were housewives and hence had a score of zero. Of the remaining 30 percent, the majority had either high or low scores. Therefore, due to the abnormal distribution of scores, the significance of the correlation between mother's profession and the intakes of niacin and ascorbic acid is questionable. No other preschool nutriture study has examined the relationship between occupation of a parent and the diet of his offspring.

The intake of thiamin showed a significant, negative correlation with the number of siblings. Neither Hendel et al. (20) nor Eppright et al. (21) observed any effect of the number in the household upon the intake of thiamin. The intake of thiamin was found to be significantly and positively correlated with the education of the father. Futrell et al. (9) did not note any effect of education of the father upon the intake of any of the nutrients or calories. The data from the present study, however, suggest a possible relationship between the number of siblings and the education of the father, such that as the education of the father increases, the number of offspring decreases.

As has been mentioned, almost 40 percent of the subjects in this investigation were siblings. This introduces a large bias into the sample. The exact effect that this bias produces, as regards the socio-environmental variables, is not known.

The geographical location (urban, rural, or metropolitan) of the child's family was not found to be related to the intake of any of the nutrients. This is in contrast to the study by Hendel et al. (20), in which the adequacy of the intake of ascorbic acid and vitamin A paralleled the degree of urbanization of the family. It is possible that the lack of correlation between dietary intake and geographical location may be due to the manner in which the variable of geographical location was designed. The variable of geographical location described the setting (urban, rural, or metropolitan) in which the largest proportion of a county's population lived; the precise location of each family's dwelling was not obtained.

Exposure to the programs of the Cooperative Extension Service did not relate significantly to the intake of any of the eight nutrients or calories among the 65 children (22 percent of the sample) whose parents received information from the Cooperative Extension Service. No other study has examined the effect of exposure to the Cooperative Extension Service upon the dietary intake of preschool children. In a report issued by the New York State College of Human Ecology (54), however, visits to pregnant homemakers by aides of the Expanded Food and Nutrition Education Program (EFNEP) of the Cooperative Extension Service resulted in an increase in the percent of women who met two-thirds of the 1974 RDA for energy, calcium, riboflavin, and niacin, as compared to women who did not receive such visits.

In this investigation, the variable of exposure to the programs of the Cooperative Extension Service was not limited to receiving visits from its personnel; publications by the Extension Service were also included. The lack of a significant correlation between this variable and the intake of any of the nutrients or calories may well be due to the small number of subjects whose families were exposed to the Cooperative Extension Service. It is also possible that the lack of a significant correlation is due to the imprecision of the variable

No significant correlation was observed between the intake of any of the eight nutrients or calories and a family's participation in a public assistance program. Eighty-seven, or 29 percent of the children came from families who were receiving public assistance at the time of sampling. In a recent study performed in Mississippi, Futrell et al. (14) reported no significant difference between those who participated in food programs and those who did not. In an earlier study by Driskell and Price (11), no significant difference was observed when the dietary intake of a group receiving food stamps was compared with a group that was not. In the present investigation, however, the variable of participation in public assistance programs was not well defined, as neither the length of time the family received assistance nor the amount of assistance the family received was known.

## The Significance of Diets High in Protein

Due to the abnormally high mean and median intakes of protein by the children in the sample, a subsample of 25 children with the highest protein intakes was compared to the 25 children with the lowest protein intakes for the following three factors: overall nutritive quality of the diet, the percentage of kilocalories from protein and fat, and the ratio of animal to vegetable protein.

The nutritive quality of the diet, using percentages of the 1974 RDA for the various nutrients and calories for comparison, was definitely superior for the group receiving large amounts of protein (Table 11). Among the 25 children with the lowest protein intakes, the mean intakes of five of the nutrients and calories were below the 1974 RDA, while three were below two-thirds of the RDA. As Table 11 indicates, however, the children with higher protein intakes also received appreciably more calories. Although greater caloric intake does not in itself insure greater nutrient intake, it does increase the opportunity to receive additional nutrients.

It is interesting to compare the data in Table 7 with those in Table 11, for it can be seen that when the level of protein intake reaches 178 percent of the 1974 RDA (the 25th percentile figure for protein intake for the 300 children in this study), only the intake of iron falls below two-thirds of the RDA. Whereas, when the level of protein intake is 110 percent of the 1974 RDA (the mean intake value of protein among the subsample of 25 children with the lowest protein intakes), the intakes of calories, calcium, and iron fall below two-thirds of the RDA.

The percent of calories from both protein and fat was greater among children with diets high in protein (Table 12). The ratio of animal to vegetable protein for the group of children with the highest intakes of protein was more than twice that of the group with the

Table 11. Comparison of nutrient and calorie intakes for subsamples[1] with highest and lowest protein intakes.

| Nutrient | Percentage of 1974 RDA (39) Highest intake group Mean ± S.D. | Percentage of 1974 RDA (39) Lowest intake group Mean ± S.D. |
|---|---|---|
| Calories | 152.0 ± 38.2 | 64.5 ± 17.2 |
| Protein | 408.0 ± 78.1 | 110.0 ± 17.2 |
| Thiamine | 154.0 ± 55.6 | 73.6 ± 29.6 |
| Riboflavin | 312.0 ± 88.0 | 77.9 ± 29.3 |
| Niacin | 161.0 ± 64.0 | 50.0 ± 15.7 |
| Vitamin A | 212.0 ± 173.0 | 132.0 ± 133.3 |
| Vitamin C | 263.0 ± 214.0 | 208.0 ± 211.0 |
| Calcium | 223.0 ± 72.1 | 52.0 ± 22.3 |
| Iron | 111.9 ± 55.4 | 60.0 ± 29.9 |

[1]Each subsample had 25 subjects.

lowest intakes of protein, indicating greater consumption of breads and cereals, proportionately, for the latter group.

Table 12. Percentages of calories from protein and fat, and ratios of animal to vegetable protein for the children (25 in each group) with the highest and the lowest protein intakes.[1]

| Group | Percent of calories from | | Ratio of animal to vegetable protein |
|---|---|---|---|
| | Protein | Fat | |
| Highest protein intake | 18.7 ± 4.2 | 36.6 ± 7.0 | 5.4 ± 2.6 |
| Lowest protein intake | 11.3 ± 2.0 | 31.6 ± 7.8 | 2.3 ± 1.1 |

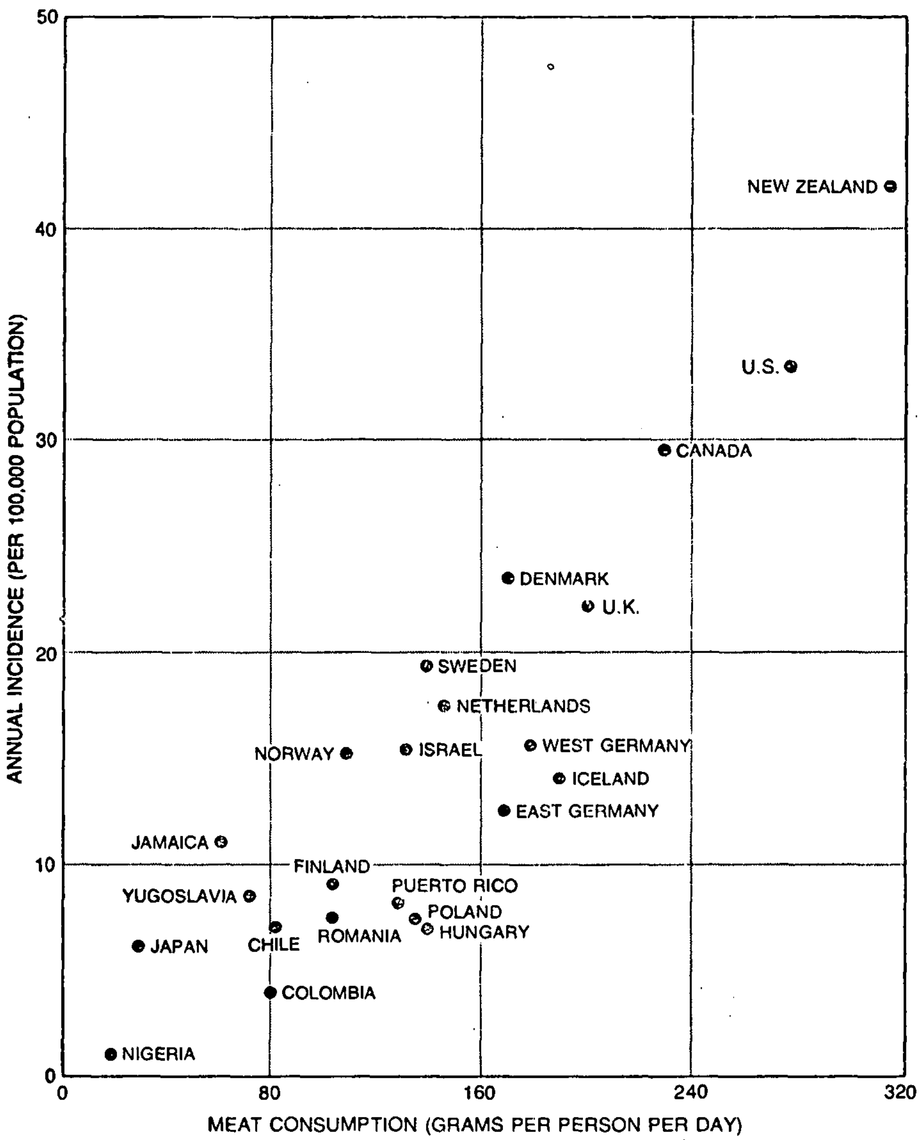
[1]Grams of fat and protein, and kilocalories were calculated using diabetic exchange lists.

When considering the significance of diets high in protein for children, it should be noted that little is known about the protein requirements of children (55). Calloway recognizes that the few data which do exist describe children who have suffered from some degree of protein-calorie malnutrition (55). Hence, data pertaining to the protein requirements of normal, healthy and growing children are not available. The 1974 edition of the RDA (39) states that the protein allowances for children were derived from information on both body composition and growth rates; no mention of the requirements for growth were made.

While it is known that growth will not take place when a diet low in protein is consumed, the physiological implications of a high-protein diet are not known. The consumption of protein that is in excess of physiological requirements leads to deamination of the extraneous amino acids, the carbon backbones of which are then modified, oxidized for energy, or stored as fat (56). Thus, since protein cannot be stored, "it is therefore not economical to feed relatively expensive high-protein foods in abnormally high quantities" (57).

Although there are no research findings which directly link morbidity with high-protein diets, there are many reports which suggest that diets high in both protein and fat may be physiologically harmful (58-63). For example, Eskimo populations ingest copious amounts of animal protein and fat. In a recent article, Mazess and Mather (64) discussed the effect of high-protein diets on the bone mineral content of Eskimos. They explained that among Eskimos, osteoporosis was seen to begin in the late twenties, versus the forties among mainland populations. These authors believed that the phosphate and sulphate radicals from the meat, particularly the sulphate, were the cause of the demineralization.

Other research which implicates the deleterious nature of diets high in both protein and fat, deals with the correlation found by some investigators (63) that the incidence of colon cancer is highest in regions in which the consumption of both animal protein and fat is high (Figure 2). The carcinogenic nature of these diets has been postulated by the following four ways: (a) formation of indole from




**GEOGRAPHY OF A CANCER** suggests a probable cause of the disease. The incidence of cancer of the large intestine among women in 23 countries is closely related to per capita meat consumption in those countries. The data are adjusted to eliminate differences in age distribution in the populations. An alternative explanation attributes cancer of the large intestine to a low consumption of cereals. The two hypotheses are hard to distinguish from each other because high meat consumption and low cereal consumption tend to go together.

Figure 2. Illustration of the relationship between meat consumption and the incidence of colonic cancer (68).

tryptophan in the colon due to tryptophanase activity of the gut microflora (60), (b) the production of ammonia by the action of the colonic mocroflora upon urea (61), (c) the formation of carcinogens, such as 20-methyl cholanthrene by the dehydrogenating action of the gut microflora upon bile acids (65, 66), and (d) the deconjugation of toxic substances by β-glucuronidase liberated by colonic microflora (59).

Some investigators have suggested that it may be the lack of fiber or bulk, and the resulting increase in transit time that is harmful (67). Research reported by Hill (66), however, indicates that the concentration of the carcinogen in the gut, rather than the transit time, is the major factor.

## Recommendations

The mean intake of protein by the children in the sample exceeded 230 percent of the 1974 RDA. Nieteen percent of the children received greater than 300 percent of the allowance. The question arises, is this amount of protein necessary? Pike and Brown (25) argue that since many of the nutrients (thiamin, riboflavin, niacin, pyridoxine, iron, calcium, and zinc) are commonly associated with proteinaceous foods, reducing the intake of protein might have serious consequences. On the other hand, the American public is constantly becoming more aware of nutrition, and is more receptive to nutrition education. Thus, if the reduction in protein intake were concomitant with a change toward greater variety in the diet, so that foods rich in thiamin, riboflavin, vitamin A, ascorbic acid, iron, and calcium were eaten more frequently, the net change might well be an increase in the overall nutritive quality of the diet.

As has been mentioned, almost 40 percent of the sample failed to receive adequate amounts of iron. While a low dietary intake of iron does not in itself indicate that these children will have anemia, a median intake of less than 75 percent of the 1974 RDA is cause for concern. Special emphasis should be placed on the iron nutriture of one- to three-year-old children, because this investigation has shown that the percentage of children with low intakes in this age group is greater than other age groups.

Even though riboflavin was supplied abundantly in the 300 dietaries examined, 15.3 percent of the children failed to receive adequate amounts of calcium. Nutrition education should focus on increasing the consumption of milk, while reducing the intake of other protein-rich sources.

More than ten percent of the children failed to meet two-thirds of the 1974 RDA for both calories and thiamin. Since the allowance for calories is based on the lowest value believed to be acceptable for growth, it is of concern that 25 percent of the study population consumed less than or equal to four-fifths of the allowance for energy (Table 7). An adequate supply of energy in the preschool years is essential for growth. An increase in the consumption of whole grain and enriched bread and cereal products would provide both the energy and the thiamin, riboflavin, niacin and iron that are needed.

Almost 20 percent of the sample consumed less than two-thirds of the 1974 RDA for ascorbic acid, this despite the fact that the majority of dietaries were recorded in the summer, when the availability of fresh fruits and vegetables is greatest. While it is possible that the actual percentage of children with low intakes of this vitamin is much lower, attention should be given to increasing the consumption of fruits and vegetables. While it is certain that fresh fruits and vegetables are among the more expensive food items, a combination of consumer and nutrition education could enable low-income families to increase their consumption of the "protective" foods.

Further studies involving the effect of socio-environmental variables upon the dietary intake of preschool children should attempt to: (1) include families of different education and income levels, (2) eliminate sample biases by including no siblings, (3) have the socio-environmental variables more clearly defined, and (4) include equal numbers of children from each of the preschool years.

# SUMMARY

We examined the dietary intake of 300 Oregon preschool children, and the relationships between dietary intake and such selected socio-environmental variables as parent's education and occupational status, the geographic location of the family (urban, rural, or metropolitan), the number of siblings, exposure to the programs and personnel of the Cooperative Extension Service, and participation in public assistance programs. The study population was drawn from 11 counties within the state of Oregon. One percent of the sample was less than 12 months, 32 percent from one to three years, 45 percent from four to six years, and 22 percent older than six years of age.

Dietary intake data were obtained by 24-hour recall or three-day records. A home economist interviewed the parent to obtain socio-environmental data.

Mean intakes of the nutrients, except iron, were higher than the 1974 allowances (39). The median intakes for both preformed niacin and iron were below the 1974 RDA. Both the mean and median intakes of protein were in excess of 220 percent of the 1974 RDA. While the mean intakes of ascorbic acid and vitamin A were close to 200 percent of the RDA, the median intakes for these vitamins were approximately 160 percent of the RDA, which indicates the irregular

distribution of these nutrients in food and the high intakes of these vitamins by a few children.

The nutrients most commonly lacking were iron, ascorbic acid, calcium, and thiamin, in that order. Almost 40 percent of the children failed to consume two-thirds of the RDA for iron, while for ascorbic acid, 19 percent were low. The percentages of children with low intakes of calcium and thiamin were 15.3, 13.0, respectively.

The socio-environmental variables considered in this study were parent's education and occupational status, the number of siblings, the geographic location of the family (urban, rural, or metropolitan), exposure to the programs and personnel of the Cooperative Extension Service, and participation in public assistance programs. The children's dietary intake data were related to the above parameters by both simple linear regression and multiple regression analysis (53).

Four of the above variables were found to be significantly[5] ($p < 0.05$) correlated with the intake of one or more nutrients: mother's education, mother's profession, father's education, and the number of siblings.

The education of the mother showed a significant, positive correlation with the intakes of ascorbic acid, thiamin, and calories.

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[5] All significant variables can be assumed to have a significance level of ($p < 0.05$) or higher.

A significant, positive correlation was found between mother's profession and the intakes of niacin and ascorbic acid. Due to the irregular distribution of the mother's occupational scores, the significance of the correlation between the intakes of niacin and ascorbic acid and mother's profession is to be questioned.

A significant, positive correlation was also observed between the intake of thiamin and father's education. A significant, negative correlation was found between the number of siblings and the intake of thiamin.

The excessive consumption of protein by the children in the sample was discussed. A subsample of 25 children with the highest protein intakes was compared to a subsample of 25 children with the lowest protein intakes for overall nutritive quality, the percentage of calories from protein and fat, and the ratio of animal to vegetable protein. The subsample of children with the highest protein intakes had far better diets, when the groups' mean values were compared. The group with the lowest protein intakes, however, had almost 90 percent fewer calories. The group with the highest protein intakes also received more calories from both protein and fat than did the group with the lowest protein intakes. The ratio of animal to vegetable protein was more than twice as high in the group with the highest protein intakes.

In conclusion, the dietary intake of the 300 children in the sample was good, as judged by mean or median intakes. Forty-one percent of the sample received greater than or equal to 67 percent of the allowance for the eight nutrients and calories. Thirty-three percent of the children received less than 67 percent of the 1974 RDA for one nutrient, usually iron. A positive, significant relationship was found between the dietary intakes of the 300 children in the sample and four socio-environmental variables. Future studies on the nutritional status of preschool children should examine the effect of the family environment as a whole on dietary intake and other parameters of nutritional status.

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# APPENDICES

## APPENDIX 1[a]

### COMPENDIUM OF STUDIES ON THE NUTRITIONAL STATUS OF PRESCHOOL CHILDREN

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Beal, V. (1) | 46 upper middle class children from Denver; ages from birth to five years | dietary intake, a longitudinal study | 1) a consistent trend toward high intakes of the macronutrients was observed<br>2) median caloric intake was just above the RDA from one to three years, and just below the RDA for three to five years<br>3) the RDA for protein fell below the 25th percentile for the first two years, in between the 25th and 50th percentiles for two to three years, and close to the 50th thereafter |
| Beal, V. (69) | as before | as before | 1) iron intakes were high from 4 to 12 months, due to consumption of enriched baby cereals<br>2) iron intakes declined thereafter, so that at one year, the 25th percentile was > RDA<br>at two years, the 50th percentile was equal to RDA<br>at three years, the RDA was > 75th percentile |
| Beal V. (40) | as before | as before | 1) the median level of intake for thiamin was slightly above the RDA, except for children from birth to three months<br>2) 75 percent of the children exceeded the RDA for riboflavin<br>3) while only 25 percent of the subjects met the RDA for niacin, protein intakes were adequate |

[a]The diverse nature of the style in which data have been reported necessitates that any compendium include data in more than one form; in this thesis, wherever possible, data will be compared to the RDA used at the time the data were published.

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Beal, V. (41) | as before | as before | 1) the RDA for vitamin A was below the 25th percentile for children one to three years only<br>2) the intake of ascorbic acid was low during the first nine months, but thereafter the 25th percentile approximated the RDA |
| Guthrie, H. (2) | 40 infants from middle class families in Pennsylvania | | 1) all but three children received two-thirds of the RDA for calories<br>2) no child received less than two-thirds of the RDA for protein; 18 exceeded the RDA<br>3) three children received less than two-thirds of the RDA for calcium<br>4) the iron intake fell below two-thirds of the RDA for 11 children<br>5) no child received less than two-thirds of the RDA for either vitamin A or riboflavin<br>6) 15 children consumed less than two-thirds of the RDA for ascorbic acid<br>7) two children received less than two-thirds of the RDA for thiamin |
| Dierks, E. & L.M. Morse (3) | 115 children, two to six years of age, all were children of students at a university in Minnesota | dietary intake | 1) two percent of the one- to three-year-olds and three percent of the four- to six-year-olds ingested less than 75 percent of the RDA for calories<br>2) protein intakes were above 75 percent of the RDA for both age groups |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Dierks, E. & L.M. Morse (3) | as before | as before | 3) nine percent of the one- to three-year-olds and three percent of the four- to six-year-olds consumed less than 75 percent of the RDA for calcium |
| | | | 4) 25 percent of the one- to three-year-old children received less than 75 percent of the RDA for iron, while four percent received less than 50 percent of the RDA for iron; nine percent of the four- to six-year-olds consumed less than 75 percent of the RDA for iron, but none received less than 50 percent of the RDA |
| | | | 5) of the one- to three-year-olds, six percent received less than 75 percent of the RDA for vitamin A, while none received less than 50 percent; of the four- to six-year-olds, nine percent ingested less than 75 percent of the RDA, three percent received less than 50 percent of the RDA |
| | | | 6) no child received less than 75 percent of the allowance for thiamin |
| | | | 7) all children met or exceeded the allowance for riboflavin |
| | | | 8) of the one- to three-year-olds, 18 percent received less than 75 percent of the RDA, four percent received less than 50 percent of the allowance for niacin; among the four- to six-year-old children, 30 percent ingested less than 75 percent of the RDA |
| | | | 9) among one- to three-year-olds, 18 percent failed to consume 75 percent of the RDA for ascorbic acid, while four percent received less than 50 percent of the RDA; of the four- to six-year-olds, 30 percent failed to meet 75 percent of the RDA, but none received less than 50 percent |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Kerrey et al. (4) | 40 children, 3 1/2 to 5 1/2, of high and low socio-economic status, from Lincoln, Nebraska | dietary intake<br>biochemical analysis | 1) mean intakes of all nutrients except iron were greater than or equal to the allowances<br>2) 17.5 percent of the sample consumed less than two-thirds of the RDA for vitamin A<br>3) 27.5 percent of the children received less than two-thirds of the RDA for ascorbic acid<br>4) 37.5 percent of the sample failed to meet two-thirds of the RDA for iron |
| Owen et al. (5) | 585 preschool children from Mississippi, ages one to six, of mixed socioeconomic background | dietary intake<br>biochemical analysis<br>clinical exam<br>anthropometry | 1) 32 percent of the sample failed to meet the dietary standard of 75 Kcal/kg<br>2) four percent of the sample did not meet the standard of 1.5 g of protein per kg<br>3) 24 percent of the sample ingested less than the standard of 400 mg/day of calcium<br>4) two-thirds of the sample consumed less than 8 mg of iron per day<br>5) 20 percent of the sample received less than the standard of 15 mg a day of ascorbic acid |
| Burroughs & Huenemann (6) | 101 children of low socio-economic status from the Coachella Valley of California, ages six months to nine years | dietary intake<br>biochemical analysis<br>frequency of iron deficiency anemia | 1) 14 percent of the subjects consumed less than 80 percent of the RDA for calories<br>2) mean intakes of protein from animal sources alone exceeded the RDA<br>3) intakes of iron were below the RDA for children less than two, but for those from two to four, were less than two-thirds of the RDA; mean intakes were ≥ the RDA for children four to nine |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Brown et al. (8) | 281 Honolulu children, age two and three years, from both low and middle class backgrounds | dietary intake<br>biochemical analysis<br>clinical exam<br>anthropometry | 1) 31 percent of the sample received less than two-thirds of the RDA for calcium<br>2) 61 percent of the subjects consumed less than two-thirds of the allowance for iron<br>3) 17 percent of the subjects received less than two-thirds of the RDA for vitamin A<br>4) thiamin intakes were below two-thirds of the RDA for 16 percent of the sample<br>5) intakes of ascorbic acid were below two-thirds of the RDA for 26 percent of the sample |
| Ho & Brown (7) | 52 infants from the lower socioeconomic class in Honolulu | dietary intake | 1) of the 11 infants for whom an accurate weight was known, none received less than two-thirds of the RDA for calories, while one of the 11 infants ingested 65 percent of the RDA for protein<br>2) the mean intake of protein for the 11 infants mentioned was 225 percent of the RDA<br>3) mean iron intakes were equivalent to 60 percent of the RDA for children six months of age and older<br>4) while the mean intake of vitamin A was greater than the RDA, three children received less than two-thirds of the RDA<br>5) the mean intake of thiamin was greater than the RDA, but four children received less than two-thirds of the RDA<br>6) the mean intake of ascorbic acid was also greater than the RDA, yet four children ingested less than two-thirds of the RDA |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Crumrine & Fryer (17) | 40 middle and upper middle class Kansas children, aged from four to six years | dietary intake<br>biochemical analysis<br>clinical exam | 1) a general trend toward high intakes nullified the validity of mean values<br>2) 25 percent of the children did not receive two-thirds of the RDA for iron<br>3) the RDA for calories, calcium and thiamin fell between the 50th and the 75th percentiles<br>4) all protein intakes were above the allowance |
| Fryer _et al._ (16) | 3500 preschool children from the North Central states, 0 to 72 months, mixed socioeconomic backgrounds | dietary intake | 1) two-thirds of the children met the RDA for calories<br>2) almost all of the children met the allowance for protein<br>3) the mean intake of protein per kg ranged from 3.4 to 5.4 |
| Fox _et al._ (45) | as above | as above | 1) median intakes of calcium exceeded the RDA for both sexes and all age groups<br>2) 95 percent of the one- to three-year-old children and 75 percent of the three- to six-year-old children did not meet the allowance for iron |
| Futrell _et al._ (9) | 139 black preschool children from Mississippi | dietary intake<br>biochemical analysis | 1) nutrients most often lacking were calcium, iron, and ascorbic acid; calories were also low<br>2) intakes of thiamin and riboflavin were adequate due to a state enrichment law |
| Acosta _et al._ (10) | 170 Mexican American children from San Diego, ages zero to six years | dietary intake<br>biochemical analysis<br>clinical exam<br>anthropometry<br>dental exam | 1) mean energy intakes were $\geq$ the RDA, yet 12 percent of the children did not receive two-thirds of the allowance for energy |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Acosta *et al.* (10) | same as above | same as above | 2) mean protein intakes were greater than the RDA, no child received less than two-thirds of the RDA |
| | | | 3) excluding children from 37 to 48 months, mean calcium intakes exceeded the RDA; 11 percent of the sample failed to receive two-thirds of the allowance |
| | | | 4) 44 percent of the sample did not meet two-thirds of the allowance for iron |
| | | | 5) while mean intakes for all age groups were greater than the RDA, 21 percent of the three-year-olds and 29 percent of the four-year-olds failed to receive two-thirds of the RDA for thiamin |
| | | | 6) despite an adequate mean intake, 29 percent of the subjects failed to meet two-thirds of the RDA for ascorbic acid |
| Driskell, J & C. Price (11) | 40 Alabama children two to five years of age, who attended a city-county clinic | dietary intake<br>biochemical analysis<br>anthropometry | 1) mean calcium and iron intakes failed to reach recommended levels for any age group |
| | | | 2) mean caloric intake fell below the RDA for the four-year-old children only |
| | | | 3) mean protein intake was greater than 185 percent of the allowance |
| | | | 4) despite a mean intake greater than 200 percent of the RDA, 40 percent of the subjects failed to meet the RDA |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Larson et al. (13) | 298 children from zero to eight years of age, whose parents were migrant workers in the Rio Grande Valley in Texas | dietary intake<br>biochemical analysis<br>clinical exam | 1) 1971 data:<br>a. intake of vitamin A and calories were below the allowances for the six- to eight-year-old subjects<br>b. mean intake of niacin was less than the RDA for the 6- to 12-month-old infants<br>c. the iron intake failed to meet the RDA for all children below three years of age<br>d. the calcium intake did not reach recommended levels for all subjects two through eight years<br>e. vitamin A and D intakes were below allowances for almost all age groups<br>2) 1972 data:<br>a. iron intakes were below the RDA for subjects one to three years of age<br>b. calcium intakes did not meet the RDA for children four to eight years of age<br>c. vitamin A and D intakes were below recommended levels of intake for all children over six months of age |
| Owen et al. (15) | 3500 children, ages one to six, a nationwide study | dietary intake<br>biochemical analysis<br>clinical exam<br>anthropometry<br>dental exam | 1) 9.1 percent of the one- to three-year-olds failed to receive three-fifths of the RDA for energy, while 14.6 percent of the four- to six-year-olds received less than two-thirds of the RDA<br>2) mean protein intakes for both age groups were close to 225 percent of the RDA; few children received less than two-thirds of the RDA |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Owen et al. (15) | as before | as before | 3) despite adequate mean intakes for both age groups, 21 percent of unsupplemented one- to three-year-old children received less than 70 percent of the RDA, while 16 percent of the unsupplemented four to six-year-olds ingested less than two-thirds of the RDA for thiamin<br>4) mean intakes of riboflavin were more than adequate for both age groups; 3.8 percent of the unsupplemented one- to three-year-olds received less than 63 percent of the RDA, while 8.5 percent of the unsupplemented four- to six-year-olds received less than 71 percent of the RDA<br>5) mean intakes of ascorbic acid were greater than recommended levels for both age groups, yet 30 percent of each age group failed to receive 75 percent of the RDA for this vitamin<br>6) although mean intakes of vitamin A were between 160 and 200 percent of the RDA, 19.3 percent of the one- to three-year-old children failed to receive 75 percent of the allowance, while 15.1 percent of the four- to six-year-olds failed to ingest 60 percent of the RDA<br>7) mean intakes of calcium for both age groups were close to the RDA, but 20.3 percent of the one- to three-year-olds and 14.3 percent of the four- to six-year-olds ingested less than 63 percent of the RDA |

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Appendix 1. (Continued)

| Authors | Subjects | Parameters examined | Significant dietary findings |
|---|---|---|---|
| Owen *et al.* (15) | as before | as before | 8) iron intakes were below the RDA for both age groups; 77.2 percent of the one- to three-year-olds failed to meet 63 percent of the RDA, while 26.4 percent of the four- to six-year-olds did not receive 64 percent of the RDA for iron (both age groups were unsupplemented) |
| Sims, L. & P. Morris (18) | 163 four-year-old children from nursery schools and public health clinics in Lansing, Michigan | dietary intake<br>biochemical analysis<br>anthropometry | 1) mean intakes of all nutrients except iron met or exceeded the allowances<br>2) 10.2 percent of the sample failed to receive two-thirds of the RDA for calcium<br>3) 13.4 percent of the children did not meet two-thirds of the allowance for ascorbic acid<br>4) 16.1 percent of the sample did not receive two-thirds of the RDA for iron |
| Futrell *et al.* (14) | 246 black four- and five-year-old children from two counties in Mississippi | dietary intake | 1) using the standards employed by the Ten-State Nutrition Survey (37), the most limiting nutrients were iron, calcium, ascorbic acid, and vitamin A<br>2) 65 percent of the sample failed to receive 82 kcal/kg<br>3) 46 percent of the sample failed to receive 450 mg of calcium<br>4) 52 percent of the sample did not meet their criterion of 30 mg of ascorbic acid<br>5) 46 percent of the sample failed to receive 2000 IU of vitamin A |

## APPENDIX 2

### DESCRIPTION OF HOW OCCUPATIONAL STATUS SCORES WERE ASSIGNED

The following scores were taken from the Handbook of Research Design and Social Measurement (51). In this scale developed by Charles Nam, occupations were given status scores ranging from 99 to 0. In this study, the scores which appear to the left were divided into groups of ten from 90 to 0, to facilitate statistical analysis. Thus, scores from 91 to 99 were changed to 90, scores from 81 to 89 were changed to 80, etc.

| Score | Category | Score | Category |
|---|---|---|---|
| | Professional, technical, and kindred | | Professional, technical, and kindred |
| 96 | College presidents, professors, and instructors | 90 | College presidents, professors, and instructors |
| 71 | Nurses, professional | 70 | Nurses, professional |
| 99 | Physicians and surgeons | 90 | Physicians and surgeons |
| | Managers, officials, and proprietors, except farm | | Managers, officials, and proprietors, except farm |
| 92 | Credit men | 90 | Credit men |
| 96 | Insurance and real estate | 90 | Insurance and real estate |
| 78 | Food and dairy products stores | 70 | Food and dairy products stores |
| | Clerical and kindred workers | | Clerical and kindred workers |
| 73 | Bookkeepers | 70 | Bookkeepers |
| 89 | Insurance adjusters, examiners, and investigators | 80 | Insurance adjusters, examiners, and investigators |
| 82 | Secretaries | 80 | Secretaries |
| | Sales workers | | Sales workers |
| 90 | Advertising agents and salesmen | 90 | Advertising agents and salesmen |
| 88 | Manufacturing | 80 | Manufacturing |
| 61 | Retail trade | 60 | Retail trade |
| | Craftsmen, foremen, and kindred | | Craftsmen, foremen, and kindred |
| 35 | Carpenters | 30 | Carpenters |
| 52 | Automobile mechanics | 50 | Automobile mechanics |
| 77 | Toolmakers | 70 | Toolmakers |

(Continued on next page)

Appendix 2. (Continued)

| Score | Category | Score | Category |
|---|---|---|---|
| | Operatives and kindred | | Operatives and kindred |
| 37 | Laundry and dry cleaning operatives | 30 | Laundry and dry cleaning operatives |
| 38 | Packers and wrappers | 30 | Packers and wrappers |
| 40 | Truck and tractor drivers | 40 | Truck and tractor drivers |
| | Private household workers | | Private household workers |
| 07 | Baby sitters | 00 | Baby sitters |
| | Housekeepers | | Housekeepers |
| 25 | living in | 20 | living in |
| 32 | living out | 30 | living out |
| | Service workers, except private household | | Service workers, except private household |
| 46 | Bartender | 40 | Bartender |
| 37 | Hairdressers and cosmetologists | 30 | Hairdressers and cosmetologists |
| 38 | Guards, watchmen, and doorkeepers | 30 | Guards, watchmen, and doorkeepers |
| | Laborers, except farm and mine | | Laborers, except farm and mine |
| 11 | Fishermen and oystermen | 10 | Fishermen and oystermen |
| 15 | Canning and preserving fruits and vegetables | 10 | Canning and preserving fruits and vegetables |
| 12 | Sawmills, planing mills, and mill work | 10 | Sawmills, planing mills, and mill work |

# APPENDIX III

## DIETARY INTAKE INFORMATION SHEETS

OREGON STATE HEALTH DIVISION AND UNIVERSITY OF OREGON MEDICAL SCHOOL

Food Intake Frequency

Instructions:

Please circle "D" if your child eats the following foods daily, "W" if he eats them weekly, "M" for monthly, "S" for seldom and "N" for never. Under kinds list specific type if appropriate such as milk, whole milk, 2 per cent, skim milk or powdered skim milk. Amounts would be whether it is approximately a cup, a slice, a teaspoon, etc. Please note whether product has nutrients added such as milk with vitamin D, cereal with vitamins and iron (list the vitamins added).

| Food | Kind | Frequency | Amount |
|---|---|---|---|
| Milk | | D W M S N | |
| Cheese | | D W M S N | |
| Ice Cream | | D W M S N | |
| Milk in cooking: Puddings | | D W M S N | |
| Cream soup | | D W M S N | |
| Gravy | | D W M S N | |
| Sauces | | D W M S N | |
| Meat: Luncheon meat | | D W M S N | |
| Sausage | | D W M S N | |
| Bacon | | D W M S N | |
| Hot dogs | | D W M S N | |
| Pork or ham | | D W M S N | |
| Beef or veal | | D W M S N | |
| Mutton or lamb | | D W M S N | |
| Meat in mixtures like stew, casseroles, taco, tamale, gravy | | D W M S N | |
| Liver | | D W M S N | |
| Chicken | | D W M S N | |
| Turkey | | D W M S N | |
| Wild game birds | | D W M S N | |
| Venison or elk | | D W M S N | |

| Food | Kind | Frequency | Amount |
|---|---|---|---|
| Other wild animals | | D W M S N | |
| Fish, fresh | | D W M S N | |
| Tuna fish, canned | | D W M S N | |
| Crab or shrimp | | D W M S N | |
| Clams or oysters | | D W M S N | |
| Eggs | | D W M S N | |
| Peanut butter | | D W M S N | |
| Nuts | | D W M S N | |
| Seeds (sesame) | | D W M S N | |
| Soyabeans | | D W M S N | |
| Peas, dried | | D W M S N | |
| Beans, dried | | D W M S N | |
| Lentils | | D W M S N | |
| Fruit, raw | | D W M S N | |
| Fruit, canned | | D W M S N | |
| Fruit juice | | D W M S N | |
| Tang | | D W M S N | |
| Vegetable, cooked | | D W M S N | |
| Vegetable, raw | | D W M S N | |
| Vegetable salad | | D W M S N | |
| Potato | | D W M S N | |
| Bread | | D W M S N | |
| Rolls or buns | | D W M S N | |
| Biscuits | | D W M S N | |
| Rice | | D W M S N | |
| Macaroni, spaghetti or noodles | | D W M S N | |
| Tortillas | | D W M S N | |
| Corn bread | | D W M S N | |

| .ood | Kind | Frequency | Amount |
|---|---|---|---|
| Cereal, dry | | D W M S N | |
| Cereal, cooked | | D W M S N | |
| Pancakes or waffles | | D W M S N | |
| Sweetrolls or doughnuts | | D W M S N | |
| Crackers | | D W M S N | |
| Cookies | | D W M S N | |
| Cake | | D W M S N | |
| Pie | | D W M S N | |
| Potato chips or other chips | | D W M S N | |
| Candy | | D W M S N | |
| Koolaid | | D W M S N | |
| Soft drinks | | D W M S N | |
| Sugar, syrup, honey | | D W M S N | |
| Jam or jelly | | D W M S N | |
| Popsicles | | D W M S N | |
| Salt, iodized | | D W M S N | |
| Salt, not iodized | | D W M S N | |
| Butter | | D W M S N | |
| Margarine | | D W M S N | |
| Other fats or oils | | D W M S N | |
| Mayonnaise or salad dressing | | D W M S N | |
| Pizza | | D W M S N | |
| Soup | | D W M S N | |

OREGON STATE HEALTH DIVISION
NUTRITION SERVICE

Twenty-four Hour Diet

NAME____________________ DATE____________ AGE________ SEX________

| TIME | WHERE EATEN | FOOD | TYPE AND OR PREPARATION | AMOUNT | AMOUNT CODE | CODE |
|---|---|---|---|---|---|---|
| | | | | | | |

COUNTY____________________

DO YOU TAKE ANY SUPPLEMENTAL NUTRIENTS LIKE VITAMINS, MINERALS OR PROTEIN? YES________ NO________

IF YES, WHAT KIND?________________ ALL YEAR IN WINTER ONLY SUMMER ONLY SOMETIMES