FACTORS AFFECTING PRESCHOOL CHILDREN'S DIETS

by

VIJAY BHALLA

M. Sc., University of Delhi
Delhi, India, 1962

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Foods and Nutrition

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1970

Approved by:

Gwendolyn L. Dinklin
Major Professor

TABLE OF CONTENTS

INTRODUCTION

Optimum nutrition is one of the best provisions for overall well being of an individual in any period of his life. Briggs (1) defined nutrition as

> "that science which deals with the identity and function of those substances in food and water required by an organism for growth, maintenance, and reproduction; with the foodstuffs which enable the organism to meet these; and with factors involved in the consumption and utilization of such foodstuffs by the individual".

Malnutrition is a general term indicating nutritional inadequacy. It may signify only slightly inferior nutritional status produced by failure to provide all of the requirements for good nutrition, or it may occur in the presence of dietary adequacy (2).

The physical status of children of preschool age is of particular concern throughout the world. It has become clear from studies in developing countries that a major share of medical and nutritional needs exist in youngsters between the ages of 1 and 6 (3). In recent studies by Senn (4) and Loyd (5), it was reported that the children in the United States also have shown signs of nutritional deficiency, stunted growth and malnutrition.

Liang et al. (6) stated that undernutrition in infancy and early childhood may cause irreversible brain damage as the development of the human brain is virtually completed by the fifth year of life. Food practices and attitudes established during the early years are believed to affect food choice and consequently nutritional status throughout life (7).

The purpose of this paper was to review the literature regarding the dietary intake of preschool children, between the ages of 2 and 6, residing in the United States. Consideration was given to the factors: food habits and attitudes towards foods; food preferences, likes and dislikes; seasonal

variations; age and sex differences and socioeconomic factors affecting the dietary adequacy. The effect of dietary adequacy on height and weight were discussed also.

IMPORTANCE OF DIETARY STUDIES

Nutritional status of groups of healthy people or individuals is judged on the basis of physical, biochemical and clinical observations combined with observations of food or nutrient intakes (8). Although dietary intake data are only a small part of a nutritional status survey they are indispensable. Essential information is obtained on nutrient intake levels, sources of nutrients, food habits and preparation practices and attitudes (9, 10). In addition, the amount of specific foods ordinarily consumed, as well as adequacy of the nutrient content of food actually consumed, are obtained. An assessment of the food eaten by an individual or group of individuals and an estimate of the nutritional composition of the food may furnish indirect evidence of malnutrition (11).

EVALUATION OF DIETARY INTAKE

The Food and Nutrition Board of the National Research Council (NRC) established the Recommended Dietary Allowances (RDA) as the "yardstick" to use in evaluating dietary intake. The RDA first published in 1943 and last revised in 1968 are used as guidelines for interpreting food consumption records and are used as reference standards (table 1).

The RDA are designed to afford a margin of sufficiency above average physiological requirements to cover variations among essentially all individuals in general population. Thus, when the RDA are used as reference standards for interpreting records of food consumption, it should not be

TABLE 1

Recommended dietary allowances for children[1]

Year	Weight	Height	KCalories	Protein	Calcium	Iron	Vitamin A Activity	Thiamine	Riboflavin	Niacin	Ascorbic Acid	Vitamin D
Recommended Dietary Allowances: Children 1 to 3 Years of Age												
	kg. (lb.)	cm. (in.)		g	g	mg	IU	mg	mg	mg	mg	IU
1941			1,200	40	1.0	7	2,000	0.6	0.9	6	35	400
1943			1,200	40	1.0	7	2,000	0.6	0.9	6	35	400
1945	13 (29)		1,200	40	1.0	7	2,000	0.6	0.9	6	35	400
1948	12 (27)		1,200	40	1.0	7	2,000	0.6	0.9	6	35	400
1953	12 (27)	87 (34)	1,200	40	1.0	7	2,000	0.6	1.0	6	35	400
1958	12 (27)	87 (34)	1,300	40	1.0	7	2,000	0.7	1.0	8[d]	35	400
1964	13 (29)	87 (34)	1,300	32	0.8	6	2,000	0.5	0.8	8[d]	40	400
1968[a]	12 (26)	81 (32)	1,100	25	0.7	15	2,000	0.6	0.6	8[d]	40	400
	14 (31)	91 (36)	1,250		0.8				0.7			
Recommended Dietary Allowances: Children 4 to 6 Years of Age												
1941			1,600	50	1.0	8	2,500	0.8	1.2	8	50	400
1943			1,600	50	1.0	8	2,500	0.8	1.2	8	50	400
1945	19 (42)		1,600	50	1.0	8	2,500	0.8	1.2	8	50	400
1948	19 (42)		1,600	50	1.0	8	2,500	0.8	1.2	8	50	400
1953	18 (40)	109 (43)	1,600	50	1.0	8	2,500	0.8	1.2	8	50	400
1958	18 (40)	109 (43)	1,700	50	1.0	8	2,500	0.9	1.3	11[d]	50	400
1964[b]	18 (40)	107 (42)	1,600	40	0.8	10	2,500	0.6	1.0	11[d]	50	400
1968[c]	19 (42)	110 (43)	1,600	30	0.8	10	2,500	0.8	0.9	11[d]	40	400

[1]Miller, D. F. and L. Voris (12).

[a]First value is for children 1 to 2 years of age: second, 2 to 3. Where recommendations are the same for both groups only one value is shown. Recommended Dietary Allowances for children 3 to 4 years of age are the same as those cited for children 2 to 3, except for kcalories (1,400), protein (30 gm.), iron (10 mg.), vitamin A (2,500 IU), thiamine (0.7 mg.), riboflavin (0.8 mg.), and niacin (9 mg.).

[b]Children 3 to 6 years of age.

[c]Recommended Dietary Allowances for children 3 to 4 years of age are the same as cited, except for kcalories (1,400), thiamine (0.7 mg.), riboflavin (0.8 mg.), and niacin (9 mg.).

[d]Niacin equivalents. Includes sources of vitamin itself plus 1 mg. equivalent for each 60 mg. tryptophan.

assumed that malnutrition exists whenever recommendations are not completely met. RDA have been used extensively as a guide in the interpretation of the adequacy of nutrient intakes of population groups (8).

The RDA have undergone periodic revisions since they were first established in 1941 (12). For children between the ages of 1 and 3, the caloric recommendations of 1200 remained the same until 1958, when they were increased to 1300. In 1968, they were reduced to 1100 for children between ages of 1 and 2, and to 1250 for children between 2 and 3 years. The only change for children between 4 and 6 years came in 1958 when recommendations were increased from 1600 to 1700. In 1964, the level of caloric recommendations was decreased again to 1600. Protein recommendations for children between the ages of 1 and 3 have been reduced from 40 g to 25 g, and for children between 4 and 6 years from 50 to 30 g. Calcium recommendations for both age groups in 1941 were 1.0 g but now stand at 0.8 g. Recommendations for iron have been increased, almost doubling for children between 1 and 3 years. Thiamine recommendations increased and decreased through the years; however, in 1968 they were again the same as they were in 1941 for both age groups. Riboflavin recommendations have decreased, whereas those of niacin have increased. Ascorbic acid recommendations have been increased from 35 to 40 mg for children 1 to 3 years old and have decreased from 50 to 40 mg for children between the ages of 4 and 6. No changes have been made in the recommendations for either Vitamin A or Vitamin D.

The standard "yardstick" for appraisal is usually the RDA. If so considered, one has to decide what point or points along the range are to be accepted as providing diets of a given quality, perhaps to be described as good, fair and poor, or as satisfactory or unsatisfactory (9). Lamb and

Ling (13) evaluated adequacy of dietary intake in terms of total diet and certain food groups. In general the quality and quantity of the protein intake is considered to be an excellent indicator of the adequacy of diet (14).

DIETARY INTAKE OF PRESCHOOL CHILDREN

Preschool children have been the subjects of relatively few dietary studies. The studies have been done in different parts of the country and will be reported here individually starting with the earliest ones found in the literature.

Eight children between the ages of 2 years, 2 months and 3 years, 7 months were studied over a period of one year by Lamb and Ling (13). Calcium and iron were found to be deficient in the diets of these children. All children studied were enrolled in Texas Technological College Nursery School.

Family food records were obtained by Young and Pilcher (15) at Groton Township, New York. The nutrient intakes showed that except for calcium, the intake was adequate for all children. Children between the ages of 1 and 10 had better food intakes than any other age group. Seventy-eight of these children were between the ages of 1 and 6. The mean nutrient intake for different ages and sexes was listed, but the intake of preschool children was not discussed as such.

Young et al. (16) studied children between 4 and 18 years. Seven-day dietary records were kept and the nutrient intakes compared with the RDA. The results obtained showed that 4 to 9 year old children consumed diets that met the RDA better than did the diets of older children. The nutrients most often listed as consumed in least amounts were calcium and iron.

Burke et al. (17) studied intakes of 125 children between the ages of

1 and 18 for calories and protein. Dietary histories were taken at 6 month intervals for children between the ages of 1 and 6 and at 1 year intervals thereafter. The average intakes of calories and protein were above the 1958 RDA except for the caloric intake of the girls from 1 to 6 years and from 12 to 18 years.

A study was made by Metheny et al. (18) on 104 children between the ages of 2 1/2 and 5 1/2 enrolled in day-care centers or nursery schools in the Columbus, Ohio area. Mothers kept 3 day consecutive dietary records. The mean intakes were then appraised for adequacy according to three levels:

1. All nutrients meeting 100% or more of the NRC recommended allowances.
2. Some nutrients less than 100% but all 67% or more of NRC recommended allowance.
3. At least one nutrient less than 67% of NRC recommended allowances.

When individual intakes were compared, it was seen that 21% children fell in level 1, 69% in level 2 and 18% in level 3. Vitamin A was supplied in more nearly sufficient amounts than any other nutrient. Iron was least well supplied. Of the diets, 37% failed to supply calcium at 100% level, whereas 40% failed to meet the energy value and 41% the thiamine. Protein was supplied by 89% of children's diets at 100% of RDA. All met 67% of the RDA for this nutrient.

Iron, calcium, calories and ascorbic acid intakes were most often inadequate in a study of children from 2 different socioeconomic groups at Lincoln, Nebraska (18 - 20) (19 - 21). Comparing the iron intakes with the RDA, 95% of the children from the high income group and 80% of the children from the low income group failed to meet the requirements. Dietary intakes for 60% of the children in both income groups were deficient in calcium. Only 55% of the children in high income group, but 65% of the children in

low income group had inadequate intake of calories. Only 35% of the children belonging to the high income group did not meet the requirements for ascorbic acid whereas 70% the children in low income group failed to meet requirements for this nutrient. When diets of all 40 children ranging from 3 1/2 to 5 1/2 years were appraised, it appeared from the mean values that children in both economic groups either met or exceeded the intakes of all nutrients except for iron and calories.

At Married Student Housing in University of Minnesota, St. Paul, Dierks and Morse (22) studied 121 children between the ages of 2 and 6. Three consecutive day dietary records were kept by the mothers of children in April and early May. The dietary intake was classified as:

1. good - when the intake was at least 75% of RDA
2. fair - when the intake was at least 50-74% of RDA
3. poor - when the intake was less than 50% of RDA

The mean total nutrient intake of all children met or exceeded the RDA for calories, protein, iron, calcium, Vitamin A, thiamine, riboflavin and ascorbic acid. Iron was the nutrient deficient for all children. When individual intakes were compared, more than 90% of the children between the ages of 4 and 6 consumed diets containing more than 75% of the allowances for calories, protein, calcium, iron, Vitamin A, thiamine, riboflavin and ascorbic acid. A substantial number of children consumed diets containing between 50 and 70% of RDA for iron and niacin. Many children consumed less than 50% of the recommendation for ascorbic acid. Relatively few of the children had intakes of individual nutrients which were under 50% of RDA. No child's diet was low in all nutrients. In many instances only one nutrient was deficient.

Forty-nine preschool children were the subjects of a study by Ling (23) in Manhattan, Kansas. Twenty-eight of these children were the members of

families receiving Aid to Families with Dependent Children (AFDC); the others included were 15 children attending Kansas State University Child Development Laboratory (CDL) and 6 of their siblings. Seven-day dietary records were kept and the mean nutrient intake was classified according to 3 levels of adequacy:

1. All nutrients meeting 100% or more of the NRC recommended allowances.
2. Some nutrients less than 100% but all 67% or more of NRC recommended allowances.
3. At least one nutrient less than 67% of NRC recommended allowances.

The AFDC children in this study had better diets than the CDL children; 7% ranked in level 1, 54% in level 2 and 39% in level 3. None of the CDL children were classified in level 1, 38% fell in level 2 and 62% in level 3.

Niacin was the most adequately supplied nutrient; followed by protein, thiamine and riboflavin. Over one-half of the children met RDA requirements for Vitamin A and ascorbic acid. Iron was the least adequately supplied nutrient. Caloric and calcium allowances were met by fewer than one-half of the children, with CDL children having lower intake in calories and AFDC children in calcium.

In another study at Manhattan, Kansas, Bilderback (24) studied the subjects whose parents lived in Married Student Housing at Kansas State University. Three-day dietary records were kept for 50 children between 3 and 6 years. All children's diets supplied food energy, protein, thiamine, riboflavin and niacin equivalents of at least 67% of RDA. More children in each age group were lower in iron intake than any other nutrient. Thirteen children out of 50 had intakes less than 67% of RDA for iron. Nine children had ascorbic acid intakes below 67% of RDA. More of the diets met 100% RDA for vitamins than they did for iron, calcium, protein, or food

energy. Iron was supplied in the least adequate amounts, followed by ascorbic acid. Niacin was the only nutrient supplied at 100% of the RDA in diets of all children.

Cowan (25) compared the diets of 27 preschool children from 2 different socioeconomic groups living in Orono, Maine. Seven-day diet records were kept and their adequacy was compared with RDA for calories, protein, calcium, iron, Vitamin A, and ascorbic acid. If the calories and nutrients met at least two-thirds of RDA, then the diets were considered to be adequate. On evaluating the diet records, it was seen that all children in the higher living level (pre-kindergarten) group met two-thirds of RDA for calories and nutrients. In the lower living level (Head Start) group, 6 of 13 children had diets considered inadequate because they met only one-third of RDA for calories and nutrients. All children's diets in higher living level group supplied protein at 100% level of RDA. Eleven of 14 children met RDA for ascorbic acid. Fewer children met the RDA for iron than for other nutrients. In the lower living level group, protein was the nutrient supplied in most sufficient amounts. Protein was followed by calcium. Diets of 9 children met RDA for calcium. Six children in this group had diets that met less than two-thirds of RDA. The nutrient most frequently lacking was ascorbic acid. Three children in the sample had a diet which was inadequate in calories and one other diet was inadequate in iron. Children in the higher living level group had diets considered more adequate than those for children in the lower living level group.

At Manhattan, Kansas, 40 nursery school children were the subjects of Crumrine (26). They ranged in age from 3 years 10 months to 5 years 9 months. Three-day dietary records were obtained and their nutrient intake calculated and categorized as highest and lowest values observed and 25th, 50th and

75th percentiles as compared to the 1963 RDA. The RDA for iron fell between the 75th percentile and the highest values observed; for ascorbic acid, Vitamin A, protein, thiamine and riboflavin, it fell between the lowest values observed and the 25th percentile. All diets supplied niacin at 100% or more of the 1963 RDA. Iron was the nutrient supplied in least adequate amounts, followed by calcium and calories. Sixteen children's diets were reinforced with vitamin supplements. The reinforcement helped little to improve the diet, except in the case of Vitamin A and ascorbic acid.

Lamb and Ling (13) in their study of 8 children found the greatest deficiency existing for green and yellow vegetables with no subject consuming even as much as 50% of the standard. The consumption was 50% or less by 4 children and only 1 child out of 8 consumed adequate amounts of this food group. Hardy et al. (27) indicated a deficiency for protein foods and most often for fruits and vegetables. Desserts in another study by Mirone et al. (28) were reported to be consumed in largest amounts whereas vegetables were consumed in least amounts.

FACTORS INFLUENCING FOOD CHOICE AND/OR DIETARY INTAKE

Man's choice of food is influenced by numerous factors including cultural background, habits, taste preferences, susceptibility of advertising, family finances, religious beliefs, economic situation and many others (29-32). Learning to eat in an acceptable manner and having acceptable attitudes towards eating falls into a certain period of a child's development; in fact it is one of the first habits the child learns. If the process of eating has been interfered with because of pressure, anxiety, or poor adult patterns, all other developments of the child may be hindered (33). Thus, establishing good eating habits at the proper developmental period is more

than a matter of being well nourished; it is a matter of growing on schedule, or becoming emotionally mature and being able to take an adequate role in adult life and, in the long run preventing a viscious cycle of poor eating habits in the succeeding generation.

Early childhood is an extremely important time, perhaps the most important for the development of food habits. Food habits and attitudes towards food learned early exert a powerful influence on the child at later periods of life and once formed are among the most difficult of any habits to change (7, 29, 34). Nutritional status and adequacy of nutrient intake of individuals depends upon what and how much people eat, what their likes, dislikes and preferences are and what their attitudes toward food may be. Few investigations reported in the literature included an evaluation of these factors in the preschool child's diet. None of them indicated the influence of these factors upon the adequacy of the nutrient intake.

Food Habits and Attitudes Towards Foods

A pattern of widely spaced meals was developed in America during earlier generations for various reasons. Long hours of labor away from home was one of the reasons. Recently, though, snacks have become part of life (35). The preschool child often supplements his diet throughout the day by eating between meals. Some children may eat more food between meals than at meal time especially if the snacks consist of crackers, dried fruit and fruit juices (36).

Dierks and Morse (22) in their study of preschool children found the percentage of total mean nutrients contributed by snacks. Their findings were indicated as follows:

TABLE 2

Percentage of total mean nutrient contributed by snacks

Group	Calories	Protein	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		g	mg	mg	IU	mg	mg	mg	mg
1-3 years									
Boys	12.1	6.8	9.1	7.6	7.1	8.2	7.4	5.9	15.2
Girls	16.0	10.4	12.7	9.7	7.3	9.5	10.3	8.1	16.2
4-6 years									
Boys	13.4	8.1	8.4	8.2	6.5	9.0	8.9	10.9	16.7
Girls	11.5	6.0	7.3	8.2	6.0	8.0	5.6	5.1	19.2

Snacks in this study on the average provided 11.5 to 16.0 % of total calories; 6.0 to 10.4 % protein; 7.3 to 12.7 % calcium: 7.6 to 9.7 % iron and 15.2 to 19.2 % ascorbic acid of total daily intake.

Forcing a child to eat is more destructive than constructive in the formation of good food habits (33). As soon as a child is forced to eat, he not only rebels against the food in question but may also be conditioned against all foods, against meal time and all associated matters. On the other hand, pleasant experience with a food is likely to produce a favorable attitude towards that food (29, 37). Surprisingly, many mothers (38) had encouraged their children to eat by:

1. restricting or withholding certain pleasures until the child eats.
2. gently urging or coaxing the child to eat.
3. referring to remote goals which may be attractive to the child.
4. granting rewards if child eats (an immediate goal).
5. reminding the child to eat (when outside distractions cause child to forget his food).

6. purposely diverting the child's attention away from his food so that he eats but does not realize he is doing so.

7. using some other method.

Food Preferences, Likes and Dislikes

Repetition of experience with specific foods and the establishment of a preference for those to which one is accustomed, becomes a food habit. It appears that food preferences may not depend alone on taste or appetite, but are also influenced by close association of the child with members of his family (39). Investigating the father's influence on young children's food preferences, Bryan and Lowenberg (40) reported that out of 36 foods chosen 6 children out of 61 and their fathers indicated that they liked or disliked 25 or more foods. Twenty children and their fathers rated 19 to 24 foods similarly and 35 children and their fathers agreed upon 19 or less foods. Mothers of 89% children acknowledged that they did not serve the foods disliked by the father or served them infrequently.

Metheny et al. (38) concluded that foods unfamiliar or disliked by the parent were likewise unfamiliar or disliked by the child. In this study, approximately one-fourth of the children had aversion to liver, cottage cheese and rye bread. Lamb, veal and liver were the meats less frequently served to the family. Eggs and peanut butter were unpopular with 10% of the children. Lowenberg (41) concluded that the refusal of a food by a child many times could be blamed upon the way the food was prepared rather than for any psychological reasons.

Ilg (36) related preferences of the child at different ages to the physical and psychological development. For example, if the 2-year old child learns the names of foods, he can give a better indication of what he

wants to eat. Carrots and beets are commonly preferred vegetables at this age. Probably the color and sweetness are involved in this choice. Butter and cheeses are also named as preferred foods for a 2-year old child. At 2 1/2 years, choosing is quite well developed and meat becomes a real favorite. At 3 years, milk shows a rise in preference and desserts and sweets are more desired. This is also the age when vegetables are more acceptable, especially raw vegetables, raw carrots, raw peas and even raw potatoes. The child likes to chew these and likes the taste better than when the vegetables are cooked. A 4-year old not only turns to food jags but goes on food strikes. Between 4 1/2 and 5 years, the child is less demanding and accepts the foods that are at hand. Nevertheless gravies, casseroles and puddings may often be refused.

Vegetables have been reported to be the least liked group in the diets of preschool children. Desserts have been found to be the most favorite foods (28, 39, 42, 43). Vegetables reported to be most frequently disliked were spinach, carrots, green beans and peas (43). However, green beans, green peas and buttered potatoes were frequently selected and buttered carrots, beets and broccoli least frequently selected by children in the study reported by Fesmire (44). Raw carrots were selected 3 times as often as cooked carrots in this study. These results compared well with those reported by Pilgrim (45), who had concluded earlier that the addition of sauces and butter to vegetables, which in themselves are not too well liked, reduced their acceptability. In the study by Eppright et al. (46), 18% of the children who had been given vegetables and 3% of the children who had been given fruits were reported to dislike or refuse these foods.

Once again, an examination of food dislikes leads one to question their importance in relation to adequacy of nutritive intake for most individuals.

many of the disliked foods are served so infrequently that the lack of use becomes of doubtful importance from a nutritional standpoint (43).

Seasonal Variations

Season is a factor that must be considered when a dietary study is undertaken to represent year round food consumption. The food habits, geographical locality and availability of food will determine to a large extent if a seasonal effect is present (25). From a review of the literature it appeared that few investigators considered this factor in the dietary studies of preschool children.

Justice et al. (47) found that the winter and spring intakes averaged less than those of the preceding fall. Young and Pilcher (15) found no essential difference in nutrients available in the spring and fall even in the rural community. In another study (42), no significant difference was found in the mean amount of calories eaten by nursery school children whether in winter or in summer. McKay and Patton (48) confirmed these results and concluded that caloric intakes of individual children varied more from day to day within each week than they did from season to season or from one year to another.

Age and Sex Differences

There are marked variations among different children at any single age and within one child from one age to another in the rate of growth, in physical and physiological functioning, and psychological and emotional development, as well as intakes of foods and the nutrients which they supply. The Recommended Dietary Allowances of the National Research Council (8) recommended the same allowances for boys and girls until the age of ten.

Age and sex differences have, however, been correlated by some investigators with dietary intakes of preschool children (17, 49-52). In general, older nursery school children eat more in toto but less per kilogram and boys tend to eat slightly more than the girls of the same age (47).

Girls between the ages of 1 and 6 years consumed fewer calories and protein than the boys in a study undertaken by Burke et al. (17). Beal (49-51) conducted many studies in the Denver, Colorado area on nutrient intakes of children from the ages of birth to 5 years. It was concluded that the intakes of calories, fat and carbohydrates increased with age. With the exception of iron and niacin, the nutrient intakes equalled or exceeded the RDA. After 3 years, iron intake level increased but from 2 1/2 to 5 years, more than 75% of the intakes remained below RDA. Niacin intakes for this age were met by only 25% of the children. Calcium intake increased between the ages of 3 and 4. Intake of protein reached a plateau between 18 months and 3 years. An increase in thiamine and riboflavin intake was seen just after 3 years of age. Vitamin D intake decreased from 1000 IU daily to 400 IU daily at the age of 5. Ascorbic acid intake for 75% of children exceeded the RDA after the age of two.

Even though the NRC recommended an increase in the intakes, a decrease in the intake of calcium, phosphorus, iron, Vitamin A and riboflavin were noticed in late infancy and early childhood in a longitudinal study by Beal (53). The subjects included in this study were between birth and 8 years. The intakes of the other nutrients either remained relatively constant or slightly increased. Then during early school years, a slow but steady rise was seen in all nutrient intakes. Sex differences in this study were noticed almost from birth. After 18 months, the differences in caloric intake became marked with boys maintaining an intake constantly higher than

girls at all subsequent ages (53, 54). Differences in the intakes of thiamine, niacin and Vitamin C between boys and girls of ages between 3 and 5 were noticed by Bethe et al. (55) in Netherlands. Boys had higher intakes of these nutrients.

After one year of age, boys maintained a higher level than the girls in the meat intake. Egg intakes were alike for boys and girls after three years of age. Until the age of three, girls had higher egg intakes. Milk intake increased after the age of 3 years (36, 53).

In a study of preschool children, Justice et al. (47) found that total nutritive intakes of boys exceeded those of girls of about the same age. When season was ruled out, total caloric and protein intakes at lunch increased with age. Korslund and Eppright (56) suggested that there may be a sex difference in taste threshhold at the preschool age, with girls being more sensitive than boys to all four tastes: sweetness, sourness, bitterness, and saltiness. Children with the lowest taste sensitivity seemed to accept a greater number of foods. Contrary to these results, Mirone et al. (28) found no significant effect of sex on quantity of food consumed during the noon meal at the nursery school. In other studies of nursery school children (23, 57) boys tended to have higher intakes of meats than the girls. Ling (23) concluded that the girls in her study had a tendency for a higher level of nutrient intake at the beginning of the month, while the reverse was true for the boys. Dunshee (42) found no difference in the amount of food eaten by boys and girls.

Socioeconomic Factors

Major socioeconomic factors influencing children's diets are income, urbanization, education of the mother, nutritional knowledge of the mother and

the number of children in the family. The problem of income maintenance and its implications for economic and social policy seems to be the most complex problem. Food costs money, and money for food runs out when the family income is too small to provide for basic essentials of living, i.e. shelter, clothing, utilities, as well as food (58). If one has insufficient money to buy enough food or to provide more expensive but essential foods such as milk, fruits and vegetables, it is almost impossible to prevent malnutrition (59). On the average, a farm family's food production provides up to 40% of food when considered dollarwise. For this reason, the dietary levels of farm families are generally speaking, less related to their money income than are the dietary levels of city families (60). On the other hand, in rural non-farm and city groups, diets and incomes are quite closely related. Generally speaking, the diets of high income families contain larger quantities of all nutrients than do those of low income groups.

Family Income. Studies of preschool children and their dietary intakes are few. Still fewer are the studies where the comparisons have been made between the level of family income and dietary adequacy of the children.

Metheny et al. (18) studied children (2 to 6 years old) of families whose income levels ranged from $3750 or less to $7250 or more per year. In their study the greatest percentage of diets, low in nutrient content, was observed among the children in the lowest income group. All children in the upper middle income families, $5501 to $7250, had good diets providing 67% of RDA or more; whereas 81% of those from families with incomes above $7250 and 79% of those in the group between $3751 and $5500 met this criterion. Contrary to these results, Ling (23) found an inverse relationship between levels of family income and dietary adequacy of the child. In similar studies (21, 25) diets of children in the higher level of the living group

were considered more adequate than diets of the children in the lower level of the living group. Children from high income group families were reported to have superior growth and nutritional status when compared to the children of the low economic group. Kerrey et al. (21) reported that the children in the low economic group received diets providing more iron and thiamine. The children from the higher income groups had diets providing more ascorbic acid and Vitamin A. Differences were also found between the two groups in the source of calories and nutrients. The bread and cereal group provided 32% of the total caloric intake for the low economic group. In contrast, milk and milk products were the important source of calories providing 26% of the total caloric intake for the high income group. The bread and cereal group was the greatest single source of iron for both groups of children, providing 33 and 42% of iron intake for the high and low groups, respectively. Thiamine was also provided in appreciable amounts by the bread and cereal groups. These findings confirm those reported earlier by Clark (60) that the source of thiamine in diets is chiefly from grain products; meat especially pork; and milk. Although consumption of milk and meat usually increase with income, that of grain products and lean pork cuts generally decrease (60).

Recently, results have been published of the studies done on 585 children in a 17 county area in Mississippi as a part of National Nutrition Survey (58, 61). It was revealed that a higher percentage of children among the low income group had low dietary intakes of calories, protein, calcium, Vitamin C and Vitamin A, when compared with the children of the higher income group. Families with less than $500/capita/year were considered to be from the low income group, whereas those with a per capita income of more than $500/year were considered to be from the high income group. Among the

children in the lowest income group, 44% were low in caloric intake, 38% in calcium, 6% in protein and 30% in Vitamin C. However, only 16% of the children were low in calories, 10% in calcium, 1% in protein and 6% in Vitamin C when they belonged to the families with an average income of $1500 or more/capita/year. Clark (60) had commented earlier that an increase in consumption of milk, fruit and vegetables by city families of medium and higher income groups results in an increase in levels of calcium, Vitamin A and ascorbic acid.

Nutritional Knowledge of the Mother. Sometimes poverty prevents families from feeding their children well. But poverty is not the only reason for malnutrition among children. The nutritional needs of infancy, childhood and adolescence parallel periods of accelerated or decelerated growth. When the child grows very rapidly, his nutritional needs increase and during the slackened growth period, the nutritional needs in turn decrease (62). The mother may have come to think in terms of the extreme importance of the child's eating large quantities of food at each meal and when the child no longer needs or wants so much food, the mother may show extreme concern. If the child senses that his eating or not eating is extremely important to the mother, this may set the stage for a power struggle in which the child uses the weapon of eating or not eating to control the adult (29, 33). Mother's nutritional knowledge at this point becomes of great importance. She must realize that the child's appetite fluctuates and even though he needs small quantities of food, well balanced diets are of prime importance.

Cowan (25) found that the nutritional adequacy of children's meals reflected the accuracy of the mother's nutritional knowledge. Ling (23), on the other hand, found no relationship between the dietary adequacy of the

child and nutritional knowledge of the mother. The nutritional knowledge of the mother appeared to be directly related to the level of her formal education, age and income level (46, 63). Young et al. (64) found that families of those homemakers who reported having studied "about what to eat" had better feeding practices both qualitatively and quantitatively than families whose mothers had not studied about foods. In the same study it was noticed that the percentage using a specific food group also became greater as education increased. This was particularly noticeable in those food groups where knowledge makes a difference, i.e., milk, cheese, and ice cream. For the citrus fruit, tomato, or cabbage group, as education increased, the increase in use of these foods also increased. The educational level had no noticeable effect on the food groups used more traditionally, such as the meat, fish, and poultry; bread, flour and cereals; or potato and other fruit and vegetable groups. A decidedly greater percentage of homemakers, with a 'minimal' knowledge of nutrition, used all basic food groups in their menus more often than did those with no nutritional knowledge. Those with some knowledge were in an intermediate position. Also, it was indicated that as nutritional knowledge increased, a higher percentage of homemakers served better quality breakfasts that included fruit, carbohydrate and protein (64).

Younger homemakers knew considerably more about nutrition than did the middle aged, who in turn knew more than the older homemaker (63, 65). Women under 45 years of age showed more interest than older women, and those with high school and college training were more interested in nutrition than those with less schooling. Metheny et al. (18) reported that past experience and education of the mother were the most influential factors guiding the mother in feeding her family. Printed material, such as cookbooks and other sources

of new recipes were rated next. Only 21% of the homemakers sought professional aid in feeding their families. The person most commonly assisting was the pediatrician. Newspapers and magazines were the sources listed as most helpful in nutrition information, according to another study (63). Next to the press, the radio was the chief source of ideas for this field.

EFFECT OF DIETARY INTAKE ON HEIGHT AND WEIGHT

Increase in height and weight are generally considered to be the criteria of growth and development in childhood and are probably the most important measure of nutritional status (66, 67). Although such data have limitations, for heredity destines some children to have smaller bones, others large; some to be short and stocky, others tall and thin (68). Height and weight in relation to age provide an index of adequacy or abundance of caloric supply of the diets for adults, infants and children. During the periods when marked interference with adequate nutrition may limit growth, the height and weight can reveal the dietary adequacy (10). The data on height and weight are obtained by relatively simple, inexpensive and reliable measurements, yet serve as an important index of nutritional status (14). Liang et al. (6) and Jackson (14) considered height as a better guide than weight to early malnutrition.

The studies on preschool children's dietary intake and its effect on height and weight are quite limited. Few investigators have tried to see the relationship and different results have been reported. Recently, Loyd (69) found that 15% of the children studied had growth retardation and some of these children were retarded by two years at age six. In another report (58) 7% of the 2 to 6 year old children were classified as severely stunted in height and weight. Both of these studies had been conducted in poverty

stricken areas of the United States where low dietary intakes of calories, protein, calcium, Vitamin C and Vitamin A were also revealed. Ling (23) found a positive relationship between weight and dietary adequacy. Children who had the least adequate diets tended to be in the lower half of the Jackson and Kelly (70) distributions for weight and height, i.e., they were lighter in weight and shorter in height. Bilderback (24) reported that children who had least adequate diets tended to be shorter and lighter than those with adequate diets. The dietary level of boys in that study was significantly correlated with height and weight. No significant correlation was found between the dietary intake of the girls and their height and weight.

Correlations between dietary score and measures of body size were also reported by Crispin et al. (71) in their study on preschool children. The height and weight and dietary intakes tended to be greater for those in the higher socio-economic status than for those in the low socio-economic status. Significant correlations were observed between dietary score and height and body weight. Caloric intake was significantly correlated with body weight in the high income group.

McKay and Patton (48) after a two year study on preschool children at Wooster, Ohio, concluded:

1. A relationship between height and total caloric intake was more significant than either weight or age in relation to total calories, although both were significant.

2. The relationship between height and total protein was somewhat more significant than the relationship between total protein and weight.

3. There was a significant relationship between total calcium intake and height, but little if any, to age and weight.

4. The relationship between phosphorus intake and height was more significant than the relationship between phosphorus intake and weight.

5. Significant relationships were found between iron intake and age, iron intake and height, and iron intake and weight. However, the highest value was between iron intake and weight.

SUMMARY

Children in the United States have been reported to show signs of nutritional deficiency, stunted growth and malnutrition. The purpose of this paper was to review and summarize studies reported in the literature regarding adequacy of the preschool children's diets and certain factors influencing food choice and/or dietary intake. Effects of dietary adequacy on height and weight were discussed also.

Pertinent literature reported that calcium and iron were the nutrients most often deficient in the diets of preschool children. However, a few investigators reported the deficiencies of ascorbic acid, calories, thiamine, protein and niacin intakes.

Food habits of the parents were reported to influence the child's dietary habits. Fruit and vegetables were reported to be most disliked foods; whereas, desserts were most liked. Seasonal variations had little effect on the nutrient intake of children. Caloric intake and nutrients fluctuated throughout infancy and early childhood. Boys were reported to consume more food than girls. In general, children from high income families were said to have better nutrient intakes than children from low income families. Contradicting results were reported about the effect of mother's nutritional knowledge on the adequacy of the preschool child's diet. Children who had least adequate diets generally tended to be lighter in weight and shorter in height. Nevertheless, a few investigators considered height to be a better guide than weight in revealing early malnutrition.

ACKNOWLEDGMENTS

The author is deeply indebted and sincerely grateful to Miss Gwendolyn L. Tinklin, Professor of Foods and Nutrition, for her assistance throughout the preparation of this manuscript. The author wishes to thank Dr. Lucille M. Wakefield, Head of the Department of Foods and Nutrition, Dr. Marjorie M. Stith, Head of the Department of Family and Child Development, and Miss Beatrice Finkelstein, Professor of Foods and Nutrition, for their helpful suggestions, serving on the committee and reviewing the manuscript.

The author expresses her deepest gratitude to her husband, Chander P. Bhalla, without whose encouragement and assistance, it would have been impossible to finish this manuscript. To her children, Anil, Sunit and Neera, she extends her love and many thanks for being very patient and understanding.

LITERATURE CITED

1. Briggs, G. M. 1969. The need for nutrition education. Jour. Nutr. Educ. 1:7.

2. Macy, I. G. 1948. Nutritional status of children. I. Expanded opportunities for dietitians. J. Amer. Diet. Ass. 24:81.

3. Owen, G. M. 1969. Evaluation of nutritional status of preschool children in U. S. Mimeographed interim report supported by: Maternal and Child Health and Crippled Children's Services, Research Grant H-170, Children's Bureau.

4. Senn, M. 1969. Prognosis on poverty. Yale Alumni Magazine. 32:28.

5. Loyd, F. G. 1969. Faces of hunger. Today's Health. 47(10):20.

6. Liang, P. H., T. T. Mie, O. H. Jan and L. T. Giok. 1967. Evaluation of mental development in relation to early malnutrition. Amer. J. Clin. Nutr. 20:1290.

7. Litman, J. J., J. P. Cooney and R. Stief. 1964. The views of Minnesota school children on food. J. Amer. Diet. Ass. 45:433.

8. National Research Council, Food and Nutrition Board. 1968. Recommended dietary allowances. pub. 1694. rev. ed. 7, National Academy of Sciences--National Research Council, Washington, D. C.

9. National Research Council, Food and Nutrition Board. 1949. Nutrition Surveys: Their techniques and value, Bull. 117. National Academy of Sciences--National Research Council, Washington, D. C.

10. Interdepartmental Committee on Nutrition for National Defense. 1963. Manual for nutrition surveys. ed. 2. National Institutes of Health. Bethesda, Md.

11. Williams, H. H., J. S. Parker, Z. H. Pierce, J. C. Hart, G. Fiala, and H. L. Pilcher. 1951. Nutritional status survey, Groton Township, New York. VI. Chemical findings. J. Amer. Diet. Ass. 27:215.

12. Miller, D. F. and L. Voris. 1969. Chronologic changes in the recommended dietary allowances. J. Amer. Diet. Ass. 54:114.

13. Lamb, M. W. and B. C. Ling. 1946. An analysis of food consumption and preferences of nursery school children. Child Develop. 17:187.

14. Jackson, R. L. 1966. Effect of malnutrition on growth of the preschool child. In: National Academy of Sciences--National Research Council. Pre-School Child Malnutrition. Primary Deterrent to Human Progress. pub. 1282. Washington, D. C.

15. Young, C. M., and H. L. Pilcher. 1950. Nutritional status survey, Groton Township, New York. II. Nutritional usage of families and individuals. J. Amer. Diet. Ass. 26:776.

16. Young, C. M., V. L. Smudski, and B. F. Steele. 1951. Fall and spring diets of school children in New York state. J. Amer. Diet. Ass. 27:289.

17. Burke, B. S., R. B. Reed, A. S. van den Berg, and H. C. Stuart. 1959. Caloric and protein intakes of children between 1 and 18 years of age. Pediatrics. 24:922.

18. Metheny, N. Y., F. E. Hunt, M. B. Patton, and H. Heye. 1962. The diets of preschool children. I. Nutritional sufficiency findings and family marketing practices. J. Home Econ. 54:297.

19. Crispin, S. C. 1964. Nutritional adequacy as related to certain anthropometric and biochemical measurements in preschool children. Unpublished Master's Thesis, University of Nebraska, Lincoln, Nebraska.

20. Kerrey, E. F. G. 1965. Relationship between dietary adequacy and certain biological indices of nutritional status in preschool children. Unpublished Master's Thesis, University of Nebraska, Lincoln, Nebraska.

21. Kerrey, E., S. Crispin, H. M. Fox, and C. Kies. 1968. Nutritional status of preschool children. I. Dietary and biochemical findings. Amer. J. Clin. Nutr. 21:1274.

22. Dierks, E. C. and Morse, L. M. 1965. Food habits and nutrient intakes of preschool children. J. Amer. Diet. Ass. 47:242.

23. Ling, L. A. 1966. Factors related to the level of dietary adequacy of preschool children from two socioeconomic groups in Riley County, Kansas. Unpublished Master's Thesis, Kansas State University, Manhattan, Kansas.

24. Bilderback, D. 1967. Dietary intake and anthropometric measurements of preschool children. Unpublished Master's Thesis, Kansas State University, Manhattan, Kansas.

25. Cowan, J. C. 1968. A comparison of the nutrition, food habits, and physical status of prekindergarten children from two different socioeconomic groups. Unpublished Master's Thesis, University of Maine, Orono, Maine.

26. Crumrine, J. L. 1969. Dietary intake and biochemical analysis of blood of preschool children. Unpublished Master's Thesis, Kansas State University, Manhattan, Kansas.

27. Hardy, M. C., A. Spohn, G. Austin, S. McGiffert, E. Mohr, and A. B. Peterson. 1943. Nutritional and dietary inadequacies among city children from different socioeconomic groups. J. Amer. Diet. Ass. 19:173.

28. Mirone, L., V. F. Torrance and C. W. Roughton. 1956. Food intake of nursery school children at noon. J. Amer. Diet. Ass. 32:707.

29. Morgan, W. L. 1962. Factors influencing children's food habits--home and community. U. S. Dep. Agr. Misc. pub. 913:35.

30. Aldrich, R. A. 1965. Nutrition and human development. 1965. J. Amer. Diet. Ass. 46:453.

31. Breckenridge, M. E. 1959. Food attitudes of five-to-twelve year old children. J. Amer. Diet. Ass. 35:704.

32. Williams, S. R. 1969. Cultural, social and psychological influences on food habits. In: Nutrition and Diet Therapy. C. V. Mosby Company, St. Louis, p. 242.

33. Poehler, H. R. 1949. Dealing in a habit clinic with eating problems of children. J. Amer. Diet. Ass. 25:696.

34. Weng, L. 1949. The child and his food. J. Amer. Diet. Ass. 25:616.

35. Lantis, M. 1962. The child consumer. Cultural factors influencing his food choice. J. Home Econ. 54:370.

36. Ilg, F. L. 1948. The child's idea what and how to eat. J. Amer. Diet. Ass. 24:658.

37. Wagner, M. G. 1954. Appetites and attitudes. A viewpoint on feeding the young child. J. Amer. Diet. Ass. 30:329.

38. Metheny, N. Y., F. E. Hunt, M. B. Patton, and H. Heye. 1962. The diets of preschool children. II. Factors in food acceptance. J. Home Econ. 54:303.

39. McCarthy, D. 1935. Children's feeding problems in relation to the food aversions in the family. Child Develop. 6:277.

40. Bryan, M. S., and Lowenberg, M. E. 1958. The father's influence on young children's food preferences. J. Amer. Diet. Ass. 34:30.

41. Lowenberg, M. E. 1948. Food preferences of young children. J. Amer. Diet. Ass. 24:430.

42. Dunshee, M. E. 1931. A study of factors affecting the amount and kind of food eaten by nursery school children. Child Develop. 2:163.

43. Young, C. M., B. G. Waldner and K. Berresford. 1956. What the homemaker knows about nutrition. IV. Her food problems, shopping habits and sources of information. J. Amer. Diet. Ass. 32:429.

44. Fesmire, R. T. 1965. The selection and consumption of food by nursery school children. Unpublished Master's Thesis, University of North Carolina, Greensboro, North Carolina.

45. Pilgrim, F. J. 1961. What foods do people accept or reject? Group attitudes and behavior toward food. J. Amer. Diet. Ass. 38:439.

46. Eppright, E. S., H. M. Fox, B. A. Fryer, G. H. Lamkin, and V. M. Vivian. 1969. Eating behavior of preschool children. J. Nutr. Educ. 1:16.

47. Justice, C. L., M. L. Mattson and C. Schuck. 1948. Some factors influencing the food intake of preschool children. J. Amer. Diet. Ass. 22:128.

48. McKay, H. and Patton, M. B. 1935. A study of food habits and physical development of preschool children over a two-year period, with special reference to seasonal variations in growth. Ohio Agr. Exp. Station Bull. 549. Wooster, Ohio.

49. Beal, V. A. 1953. Nutritional intake of children. I. Calories, carbohydrates, fat and protein. J. Nutr. 50:223.

50. Beal, V. A. 1954. Nutritional intake of children. II. Calcium, phosphorous and iron. J. Nutr. 53:499.

51. Beal, V. A. 1955. Nutritional intake of children. III. Thiamine, riboflavin and niacin. J. Nutr. 57:183.

52. Beal, V. A. 1956. Nutritional intake of children. IV. Vitamins A and D and ascorbic acid. J. Nutr. 60:335.

53. Beal, V. A. 1961. Dietary intake of individuals followed through infancy and childhood. Amer. J. Public Health 51:1107.

54. Beal, V. A., B. S. Burke, and H. C. Stuart. 1945. Nutrition studies on children living at home. I. Calorie intakes on the basis of age from one through ten years. Amer. J. Dis. Child. 70:214.

55. Bethe, J. G. F., B. J. Bethmeier, and C. J. Biesheuvel. 1968. Nutritional state and nutrition of toddlers in Almeto (1953-54). Nutr. Abstr. Rev. 38:1257. (Original not seen).

56. Korslund, M. K. and E. S. Eppright. 1967. Taste sensitivity and eating behavior of preschool children. J. Home Econ. 59:168.

57. Tully, G. S. 1967. A study of nutritional adequacy. Mealtime staff communication and food acceptance in relation to three to five year old children living in a public institution. Unpublished Master's Thesis, University of Maryland, University Park, Maryland.

58. Egan, M. C. 1969. Combating malnutrition through maternal and child health programs. Children. 16:67.

59. Bogert, L. J. 1960. Malnutrition: how to detect and overcome it. In: Nutrition and physical fitness. ed. 3. W. B. Saunders Company. p. 530.

60. Clark, F. 1957. Family diets today. In: Proceedings of Nutrition Education Conference. April 1-3, 1957. U. S. Dep. Agr. Misc. pub. 745.

61. Anonymous, 1968. Nutrition here and there. Children. 15:244.

62. Peckos, P. S. 1957. Nutrition during growth and development. Child Develop. 28:273.

63. Anonymous, 1948. What does the housewife know about nutrition? J. Amer. Diet. Ass. 24:542.

64. Young, C. M., K. Berresford and B. G. Waldner. 1956. What the homemaker knows about nutrition. III. Relation of knowledge to practice. J. Amer. Diet. Ass. 32:321.

65. Young, C. M., B. G. Waldner, and K. Berresford. 1956. What the homemaker knows about nutrition. II. Level of nutritional knowledge. J. Amer. Diet. Ass. 32:218.

66. Copperstock, M., E. Morse, E. Z. Moyer, and I. G. Macy. 1948. Nutritional status of children. IV. Nutritional conditioning in a health camp. J. Amer. Diet. Ass. 24:205.

67. U. S. Department of Health, Education and Welfare. Social and Rehabilitation Service. Children's Bureau. 1967. Suggested guidelines for evaluation of the nutritional status of preschool children.

68. Macy, I. G. 1948. Nutritional status of children. I. Expanded opportunities for dietitians. J. Amer. Diet. Ass. 24:81.

69. Loyd, F. G. 1969. Finally facts on malnutrition in the United States. Today's Health 47(9):32.

70. Jackson, R. L., and H. G. Kelly. 1945. Growth charts for use in pediatric practice. J. Pediat. 27:215.

71. Crispin, S., E. Kerry, H. N. Fox, and C. Kies. 1968. Nutrition status of preschool children. II. Anthropometric measurements and interrelationships. Amer. J. Clin. Nutr. 21:1280.

FACTORS AFFECTING PRESCHOOL CHILDREN'S DIETS

by

VIJAY BHALLA

M. Sc., University of Delhi
Delhi, India, 1962

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Foods and Nutrition

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1970

Preschool age is an important part of life for mental, physical and psychological development. One of the best provisions of well being at any period of life is good nutrition. Children in the United States have been reported to show signs of nutritional deficiency, stunted growth and malnutrition. The purpose of this paper was to review and summarize studies reported in the literature regarding adequacy of preschool children's diets and certain factors influencing food choice and/or dietary intake. Effects of dietary adequacy on height and weight were discussed also.

Pertinent literature reported that calcium and iron were the nutrients most often deficient in the diets of preschool children. However, a few investigators reported deficiencies of ascorbic acid, calories, thiamine, protein and niacin intakes.

Food habits of parents were reported to influence the child's dietary habits. Fruit and vegetables were reported to be most disliked foods; whereas, desserts were most liked. Seasonal variations had little effect on the nutrient intake of children. Caloric intake and nutrients fluctuated throughout infancy and early childhood. Boys were reported to consume more food than girls. In general, children from high income families were said to have better nutrient intakes than the children from low income families. Contradicting results were reported about the effect of mother's nutritional knowledge on the adequacy of the preschool child's diet. Children who had least adequate diets generally tended to be lighter in weight and shorter in height. Nevertheless, a few investigators considered height to be a better guide than weight in revealing early malnutrition.