

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

FACTORS AFFECTING FOOD INTAKE: COMMITTEE ON NUTRITION

Pediatrics 1964;33;135

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ACCEPTANCE OF PRESIDENCY

THIRTY-THREE men have held this office before me—thirty-three of the greatest names in Pediatrics. With such a heritage I feel very grateful and humble.

It has been my good fortune to have known most of these men personally, and to the following three, I am particularly indebted: Dr. J. B. Bilderback, who was my teacher; Dr. Henry Dietrich, under whom I had my residency; and Dr. Jay I. Durand who was the first to interest me in our Academy and who was always an inspiration to me.

The founders and officers of the Academy who have served before me have set the purpose of the voyage of the Good Ship Ameri-

can Academy of Pediatrics; the Executive Board of the Academy continually reviews our problems and charts our course; the Executive Director and Central Office staff arrange the cargo, but you—the stock holders—must work the cargo if our voyage is to be successful. I will try to the best of my ability to run a happy and efficient ship—and hold her steady as she goes.



Seattle 22, Washington

Delivered at the Annual Meeting of the American Academy of Pediatrics, October 9, 1963.
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FACTORS AFFECTING FOOD INTAKE

COMMITTEE ON NUTRITION

EVEN in the midst of an abundant food supply and adequate knowledge of nutrient requirements, faulty nutritional practices may lead to specific deficiencies or to gross overnutrition. The Committee has therefore thought it desirable to call attention to certain emotional, cultural, and educational factors that determine or modify food intake and to discuss variations in food intake that occur in relation to age, sex, energy expenditure, deficiency of specific nutrients, presence of certain illnesses, and administration of various medications.

An attempt will be made to answer, at least in part, some of the following questions believed of interest to the practitioner: How do familial and social factors influence type and quantity of food ingested?

Will eating between meals "spoil the appetite"? Is food intake in later life likely to be influenced by dietary habits established in infancy and early childhood? Can appetite be relied upon as a guide to proper nutrient intake? Under what circumstances will various B vitamins, iron, or other specific nutrients serve as effective "tonics" to stimulate appetite?

No attempt will be made to review the neural, physiologic, or chemical bases for hunger and appetite or to consider the etiology and management of obesity.

DEFINITIONS

Considerable differences of opinion appear to exist among clinicians, physiologists, psychologists, and anthropologists with re-

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PEDIATRICS, January 1964

spect to precise definitions of hunger, appetite, and satiety. However, it is generally agreed that *hunger* is a biologic phenomenon and at least predominantly unlearned and unconditioned, while *appetite* has strong emotional connotations being primarily a learned response and intimately associated with memory of past experiences with food. *Anorexia* may be considered to represent the absence of a desire for food in circumstances in which one might ordinarily anticipate such a desire. *Satiety* is a lack of desire to eat that ensues after eating and is determined primarily by post-ingestion factors. *Palatability*, on the other hand, is related to preingestion factors, including taste, aroma, texture, temperature, appearance, and recollection of past experiences.

EMOTIONAL, CULTURAL, AND EDUCATIONAL FACTORS

Emotional Factors

The very young infant will generally cry until fed but by four or five months of age may stop crying when he hears his mother's footsteps or sees that the formula is being prepared, presumably having learned to anticipate and to wait for the relief of hunger pain. In later life, the period of tantalizing anticipation before a meal may actually be considered pleasurable. The repetitive cycle of nutritional and emotional gratification during infancy becomes further associated with the person giving the food, usually the mother, so that being loved and fed come to be associated in the mind of the infant.

Even on a physiologic basis, some similarity seems to exist between response to a loved person and response to food. The rate of secretion of hydrochloric acid in the stomach of a 15-month-old girl with gastric fistula was shown¹ to increase during periods of social contact with a loved person and to decrease when approached by a stranger.

In later childhood, mealtime, food, and eating take on further emotional connotations as the association widens to include

feelings toward home, members of family and, eventually, social implications of friendship, good fellowship, and well being. Conversely, mealtime may come to be intimately associated with fear of punishment or conflict with the parent. Thus, feeding, which in early infancy may have represented merely the relief of uncomfortable feelings of hunger, eventually becomes associated with such diverse feelings as love and approval, defiance and fear.

Cultural Factors

Although we tend to think of food taboos in relation to strange and seemingly irrational practices of primitive societies, such taboos are actually common in our own society also. For example, we eat pig, but not dog, live oysters but not live shrimp, duck eggs and duckling but not the three-quarter-grown duck embryo considered a delicacy in the Philippines.

Cultural factors in dietary choice have been well discussed by Lee.² In certain cultures it is customary to eat dragon flies, locusts, crickets, water bugs, beetles, earthworms, and eyeballs, all of which most Americans would find repugnant. Conversely, Americans often have a keen appetite for milk, which is considered repulsive in certain other societies. Even the appetite at a specified season of the year or time of day may be based largely on cultural factors. Thus, a particular appetite for turkey is common at Thanksgiving time. At breakfast Americans are likely to have an appetite for ham and eggs but not for roast pork. In view of such irrational practices, the child who craves ice cream for breakfast need not be considered by his parents to be ill or perverse; he may be merely less regimented by culture than are the adult members of his society.

In America, where obesity is unfashionable, many women avoid eating rich desserts, cream in their coffee, and butter on their toast despite an appetite for these foods. In certain other cultures young women stuff themselves with equivalent foods, even though they may lack appetite

for them, in an attempt to achieve a fashionable plumpness.

The scale of values varies to some extent from one age group to another and from one family to another. For example, in our society, a plump toddler is considered attractive but leanness is considered an asset after childhood. The pressures exerted upon an individual to attain an acceptable body physique are likely to be most acute during adolescence. In families in which the parents did not have sufficient food when they themselves were children, undue emphasis on food and eating is not uncommon. Parents' complaints regarding poor appetite of such children may be unfounded when considered in light of actual food consumption and need.

That choice of food can have moral implications for a child has been suggested by Mead.³ Similarly, Dubo⁴ has pointed out that children with tuberculosis not uncommonly attribute their illness to ingestion of the "wrong" foods or to failure to eat the "right" foods.

Eating between Meals

Among the cultural factors most strongly ingrained in our society is the pattern of three meals daily. Most parents consider it undesirable for their children to eat extensively between meals either because such eating is likely to lead to obesity or because it "spoils the appetite" at mealtime and therefore may interfere with nutrition. On the basis of animal studies and a few observations relating to man, it has been suggested⁵ that a specified intake of calories and other nutrients taken by an individual in small amounts at relatively frequent intervals may be more desirable than ingestion of *the same quantity* of food in larger, spaced meals. Our familiarity with eating of spaced meals has apparently led to acceptance of a belief that this is nutritionally sound. Clearly, the existing cultural pattern is difficult to modify, but physicians who realize that nutritionally sound reasons do not exist for spaced meal eating may be able to help parents to view in proper perspec-

tive the desires of their children to eat between meals.

A word of warning may be necessary when extensive eating between meals is customary since "snacks" are frequently rich in carbohydrate and relatively low in content of other nutrients. A permissive attitude concerning frequency of eating should not be allowed to interfere with attainment of recommended intakes of all essential nutrients. Excessive caloric intake must also be avoided.

The effect of eating between meals on total caloric intake has been the subject of relatively few studies. Caloric intake has been shown⁶ to be greater when children are permitted a snack between meals than when no snack is provided. A snack consisting of milk may represent an exception since it would appear that milk is slower to leave the stomach than most other foods and influences appetite for a longer interval after ingestion.⁷

Educational Factors

An appetite for a particular food may develop in experimental animals as a result of beneficial experience after ingestion of the food. For example, preference exhibited by thiamine-deficient rats for diets containing thiamine can probably be best explained on the assumption that a sense of well-being occurred after such ingestion.⁸ When the habit of ingesting the thiamine-containing food has been established, removal of thiamine from the food did not change the habit. This and other evidence suggests that in animals at least "new habits tend to form in agreement with bodily needs, but established habits tend to persist as regulators of food selection even when the food selections are out of line with bodily needs."⁹

Although it is difficult to establish the reasons for widespread overeating which leads to our national problem of obesity in adult life, certain speculations may be offered. Frequently repeated remonstrances of parents to their children to "clean your plate" and "drink your milk" may establish

unfavorable dietary patterns that will persist into adult life. Similarly, the practice of offering candy or other food as a reward for good behavior or as consolation in time of unpleasant experience is open to question. It seems possible that children who are unable to derive sufficient pleasure and satisfaction from other pursuits may turn increasingly to eating as a primary satisfaction.

UNGUIDED FOOD SELECTION

Human populations have demonstrated great ability to choose foods in accordance with physiologic needs provided their choice was not unduly influenced by education, imitation, social, economic, religious, or other considerations.¹⁰ Similarly, there is no doubt that under certain experimental conditions animals are able to select an adequate diet from a diverse assortment of nutrients. Rats given access to 11 substances (including casein, sucrose, olive oil, sodium chloride, dried baker's yeast, cod liver oil, wheat germ, and water) in separate containers made selections conducive to excellent growth and normal reproduction.¹¹ A number of observations indicate that other animals may also make favorable selections of food or seek out specific nutrients in which the diet is deficient.¹⁰

Nevertheless, abundant evidence⁹⁻¹³ indicates that intake of food by experimental animals is often unpredictable and individual animals vary in their ability to make nutritionally favorable choices. Scott¹³ reported that only 53 of 89 rats of a mixed strain appeared to have an appetite for casein. Those that apparently did not like casein ate less than 0.1 gm/day, lost weight, and died within a short period. Harris *et al.*⁸ showed that thiamine-deficient rats were unable to distinguish thiamine-containing foods if too many choices of foods were offered, if the thiamine content of the foods was less than adequate, or if thiamine, after being in one food, was transferred to another food with a different flavor.

In the classic experiments of Davis,¹⁴ vigorous, healthy infants and toddlers were

offered a variety of simple foods under conditions that precluded the handing down of dietary information or experience by either example or instruction. Under these circumstances it was not uncommon for a child to eat an entire meal of one or two items, e.g., eggs and bananas. Such patterns of eating were usually of short duration and a more varied intake was the rule. Growth in length and gain in weight were normal; the children remained free from symptoms of indigestion and appeared normally resistant to disease. However, it seems likely that the satisfactory performance of these infants may be an indication that random eating from a well-chosen list of foods is sufficient to avoid development of deficiency diseases. The infants might not have fared as well if the diet had contained a greater number of foods that were deficient in various nutrients.

The craving for salt exhibited by children with cystic fibrosis of the pancreas or adrenogenital syndrome with salt-losing state would appear to be a special instance in which voluntary food selection is a relatively reliable guide to need. Similarly, the intense thirst of patients with diabetes insipidus seems to be related to need for water although equally intense thirst is characteristic of otherwise normal individuals with the syndrome of habitual or psychogenic water ingestion.

VARIATIONS IN FOOD INTAKE

Knowledge of variations in food intake is somewhat limited because of the inadequacy of nutritional history as a method of determining food intake. Depending on the type of history taken, one group of obese patients was found to have a food intake of 600 calories per day greater than was revealed by a different form of questioning.¹⁵

Influence of Age, Sex, and Sensory Stimulation

On the basis of nearly 1,400 nutritional surveys, Beal¹⁶ has provided information concerning the mother's assessment of her

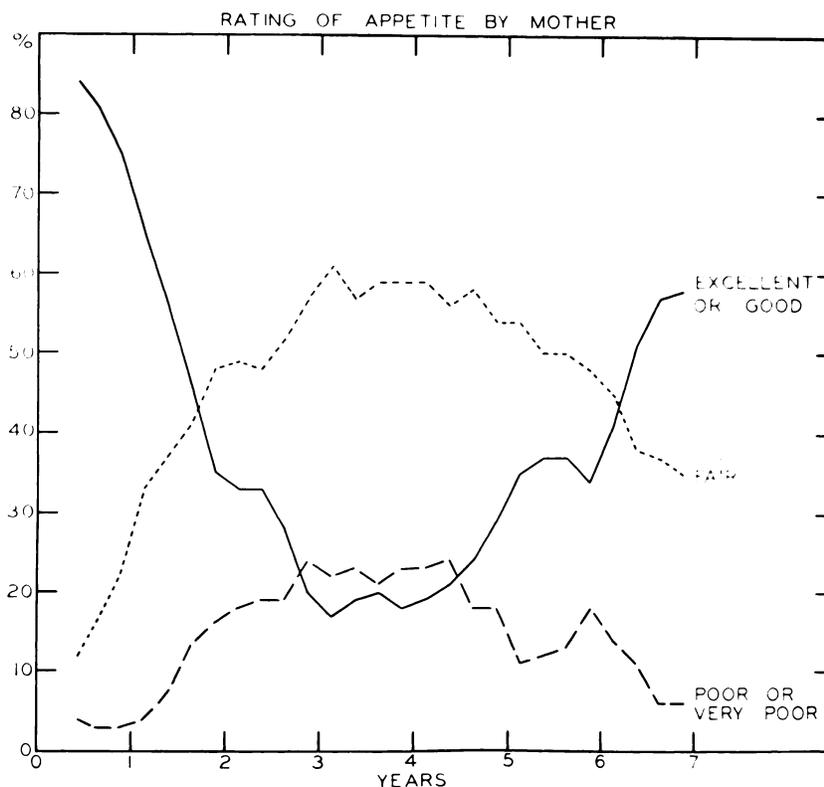


FIG. 1. Evaluation of child's appetite by mother.
(From Beal, *PEDIATRICS*, 20:448, 1957.)

child's appetite (Fig. 1). It would appear that a great many mothers are dissatisfied with the food consumption of their children, especially with reference to children between the ages of 2 and 6 years. Undoubtedly, much of this dissatisfaction results from lack of knowledge concerning normal patterns of variation in food intake.

A number of nutritional histories¹⁷⁻¹⁹ have indicated that maximal caloric intakes of girls, averaging about 2,500 calories daily, is reached between the ages of 13 and 16 years, while maximal intakes of boys, averaging nearly 3,500 calories daily, is reached between the ages of 15 and 18 years.

Not only are caloric requirements of active, rapidly growing adolescents almost certainly greater than those of most adults, but the severe emotional stresses characteristic of this age may lead to overeating. On the other hand, motivation for dieting may at times be so great, especially in girls, that

food intake becomes severely limited despite intense desire for food.

As previously mentioned, aroma, appearance, temperature, and taste may be important in the stimulation of appetite. The ritual of preparation and serving of food may also stimulate appetite. Food prepared and presented in an attractive manner is much more likely to be eaten than the same food presented in a less "appetizing" way.

Individual Variability

Results of longitudinal studies¹⁷⁻¹⁹ have indicated extreme variability in intakes of food by children of the same age and sex. In addition, food intake of a specified child usually varies considerably in relation to that of his peers. In a study by Burke *et al.*¹⁸ intakes of food by individual subjects were considered in three age intervals—1 to 6 years, 6 to 12 years, and 12 to 18 years—and

were classified as high, medium, or low in relation to intakes of other children of the same age and sex. Only one-third of the children persisted in the same classification (i.e., always high, always medium, or always low) in all three age intervals.

Environmental Temperature

Studies with a number of experimental animals²⁰ have demonstrated that voluntary ingestion of food decreases sharply at high environmental temperatures. The specific temperature necessary for depression of food intake varies considerably from one species to another. Brobeck²⁰ has suggested that decrease in appetite occurs when environmental temperature has reached a point at which maintenance of body temperature becomes difficult for the animal. At this point, heat resulting from ingestion of food would interfere with maintenance of body temperature. This theory is obviously attractive as an explanation for the "poor appetite" frequently reported during hot weather.

Caloric Expenditure

Moderate activity, such as walking for one hour, involves the expenditure of only about 100 calories, a loss of energy easily replaced by ingestion of only one slice of bread and butter. Hence, there has been a tendency in recent years to consider weight control primarily in terms of food intake. However, a decrease in energy expenditure of 100 calories daily without concomitant change in caloric intake will result in weight gain of approximately 1 lb per month or 12 lb yearly.

Because the day-to-day relation between caloric expenditure and caloric intake is not regular in adults,²¹ it seems unlikely that it is regular in children. The observation that a child has "played hard all day" and yet "has no appetite" is therefore not to be considered a sign of illness. Fatigue itself is likely to interfere with appetite and severe fatigue may cause anorexia.

Consideration of the relation between caloric intake and energy expenditure is of

particular importance in regard to management of children whose activity must be restricted for medical reasons.

Satiety Values of Specific Foods

Little information is available concerning relative satiety values of foods with differing percentages of protein, carbohydrate, and fat. In studies of obese adults receiving calorically restricted diets, relatively high intakes of protein have been reported²² to be more satiating than relatively high intakes of carbohydrate or fat. Similar studies carried out with nonobese adults and with children would be of great interest.

Available evidence²³ does not permit the conclusion that variations in content of linoleic acid exert a significant effect on the satiety value of a feeding unless the amount of linoleic acid in the feeding is relatively low, i.e., supplies less than 1% of total calories. Since even whole cow milk supplies 1% of total calories as linoleic acid, supplementation of the diet with foods rich in linoleic acid will rarely influence its satiety value.

Increased Food Intake

Increased food intake is characteristic of patients with cystic fibrosis of the pancreas, hyperthyroidism, diabetes mellitus, and epinephrine-producing tumors of the adrenal medulla. It is also observed in patients receiving ACTH, adrenal cortical steroids, androgens, estrogens, and isoniazide. Tumors of the hypothalamic region and certain traumatic and inflammatory lesions of the brain may excite hyperphagia. Studies in animals have demonstrated that lesions of the hypothalamus at the level of the ventromedial nucleus induce obesity by increasing food intake, and that lesions of the lateral areas of the hypothalamus (or of both ventromedial and lateral areas) abolish or markedly diminish food intake.²⁴ The medial area has been called the "satiety center" and the lateral areas the "feeding centers." The function of these hypothalamic centers is either to inhibit or to fa-

cilitate visual, auditory, olfactory, tactile, gustatory, or gastrointestinal "feeding reflexes," as well as reflexes of attention, approach, examination, ingestion (including chewing and swallowing), and rejection of food.²⁵ From the reflexes involved, it would appear that the regulatory system projects beyond the hypothalamus.

In patients with cystic fibrosis of the pancreas, the absence of pancreatic enzymes is apparently responsible for rapid emptying of the stomach after ingestion of food,²⁶ with resultant failure of ingested food to promote satiety.

Decreased Food Intake

When growing animals are given nutritionally inadequate diets, food intake generally decreases, presumably because the desire to eat decreases if food is not suitable for synthesis of tissue. Regardless of the mechanism, dietary deficiency of any essential nutrient is likely to be associated with decrease in voluntary intake of food.¹⁰

Food intake is generally decreased in acute and chronic febrile illnesses, in debilitating illnesses such as rheumatoid arthritis and ulcerative colitis, in certain hepatic and renal diseases, in hypothyroidism, and in various deficiency states. Reasons for decreased intake are unknown. Studies with animals²⁷ indicate that fever itself may decrease food intake.

"Tonics" for Poor Appetites

Vitamins act as appetite stimulants only in the presence of a deficiency state. This point has been emphasized in a previous report of the Committee.²⁸

A number of studies with older children indicate that response to administration of vitamin B₁₂ is evidenced by increased appetite and rate of growth and suggest by inference that some individuals in the United States are deficient in vitamin B₁₂.²⁹ Vitamin B₁₂ deficiency, if it exists, may be explained by individual variations in requirement, in dietary intake, and in extent of absorption.

Many clinicians have noted that anorexia

is a common symptom of iron deficiency anemia in infants and children. Adequate iron therapy results in prompt increase in intake of food,³⁰ and within 7 to 14 days a predictable rise in reticulocyte count and in concentration of hemoglobin. There is no evidence to indicate that deficiency of iron in various enzyme systems occurs in the absence of iron deficiency anemia and therefore the use of iron as a "tonic" or appetite stimulant does not seem reasonable.

Pharmacologic Agents for Suppression of Excessive Appetite

Drugs that have achieved the greatest acceptance as anorexigenic agents are the sympathomimetic amines. The various consequences of the central stimulation produced by these agents, including anxiety, increased mental and physical activity, and insomnia, cannot be separated from the anorexigenic action.³¹ Perception by experimental subjects of the central stimulating effects of these drugs has made the double-blind method of evaluation difficult and has confused efforts at comparative evaluation of various preparations. The myriad of drugs of this type on the market strongly suggests the lack of clear-cut superiority of any and the limited effectiveness of all.

The appetite depression induced by these agents may be short-lived and may lead to habituation. D-amphetamine has strong appetite depressing and central nervous system stimulating effects. Fazekas³² considers phenmetrazine to have less central stimulating effect and equivalent anorexigenic potency. Many of these agents have been combined with bulk producers, sedatives, tranquilizers, cathartics, thyroid extract, or smooth muscle relaxants for increased effectiveness. None has been clearly shown to offer advantages not offset by undesirable side-effects.

SUMMARY

Emotional and cultural factors are of exceptional importance in determining food intake. The deeply ingrained pattern of

three meals daily may be the cultural factor most open to criticism.

In experimental animals, and probably in the human, established nutritional habits are particularly potent factors in determining food intake. Proper nutritional education in early childhood may establish patterns of food selection that will be helpful in avoiding specific deficiencies and gross excesses in later life.

Appetite may prove adequate for selection of a nutritionally acceptable diet under certain circumstances but selection of food on the basis of nutritional principles is more reliable and is to be recommended.

A knowledge of normal variations in food intake in relation to age, sex, environmental temperature, and caloric expenditure is beneficial in interpreting the feeding behavior of children. Complaints by parents that their children have "poor appetites," are commonly based on a misconception regarding normal patterns of food intake.

Vitamins, iron, and other specific nutrients act as appetite stimulants only in the presence of deficiency of the particular nutrient.

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Pediatrics 1964;33:135

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