

development. They are comparable at birth to an average one-year-old full-term baby. There is an unusual increase to 3 months of age, which is followed by the usual decrease. These findings are discussed.

Fibula length, obtained by fibulometry, appears to be a constantly reliable measure of linear growth. It is highly repeatable and accurate. Its correlation with lying length is given and discussed.

Two groups of premature babies were given formulas of different concentrations but of the same volume. Irrespective of birth weight group, those offered and taking the stronger formula (average, 42 calories per ounce) had a greater gain in weight and hence a highly significant shorter hospital stay than those taking the weaker formula (average 26 calories per ounce).

There was a more rapid gain in weight in the shorter-stay group. Reasons for this with advantages and disadvantages in increased caloric feeding are discussed.

We acknowledge the great help of Student Research Scholars Anna McHargue, Gerald Phelps, and Joseph Hiller; Research Assistants Margaret Speckman and Said Mansour; and Richard P. Westland, Physical Anthropologist to the Child Development Unit, in the collection and computation of the data. The x-rays for fibulometry were taken under the guidance of Doctor J. T. Ling in the Department of Radiology, University of Louisville. He and his staff are most gratefully thanked for their co-operation and skill.

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TROPICAL
PEDIATRICS

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The children of the Hadza hunters

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THE Hadza, or Watindiga, who number only about 800 in all, inhabit the extensive area of tsetse-infested savannah bush adjacent to Lake Eyasi in northern Tanganyika (Figs. 1 and 2). They are an isolated, somewhat short-statured (Fig. 3), click-speaking group, and their origin and their relationship to other click-speaking people, such as the Kung Bushmen of South West Africa¹ and to the original cave painters of East Africa, are matters of speculation.

MODE OF LIFE

These people do not keep domestic animals of any sort and only one small peripheral group has adopted agriculture after intermarriage with the neighboring Isanzu tribe. The women are food gatherers who

search with digging sticks for yamlike roots and gather a wide variety of wild fruits and berries (Fig. 4). The men collect wild honey, but are principally hunters, using exceptionally powerful bows and arrows coated with plant poisons (adenium and strophanthus), which are shot into the animal's abdomen if possible. Game killed by lion and other predators, its presence shown from afar by circling vultures, is also eaten—often in a state of putrefaction.

The Hadza, partly on account of their nomadic hunting life and their unique and difficult language, have made very little contact with other tribes except for exchanging honey, skins, and giraffe tails with the neighboring Mbulu for clothing, beads, gourds, pots, knives, tobacco, hashish (*Cannabis indica*), and metal for arrowheads. This contact is in fact accelerating due to the clearing of trees as part of a government tsetse eradication scheme, and the subsequent movement into Hadza country of cattle-owning people at present excluded by tsetse-borne animal trypanosomiasis. Yet another link with neighbors is due to dependence on the Isanzu for medicines and medical treat-

Community Child Health Studies, No. 3, in East Africa.

Supported by funds from the Research Committee, Makerere University College, and from the Nestlé Malnutrition Research Grant.

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ment, for previously there was no contact with European medicine.

Mobility is the essence of the Hadza way of life, since proper exploitation of the environment for food and water demands constant moves, especially in wet weather when animals no longer have to frequent a limited number of water holes. Property is minimal, so that a man might own bows, arrows, a knife, an axe, a stone pipe, a skin shoulder bag, beads, clothing being worn, and objects of ritual importance: a plume of ostrich feathers, and a decorated gourd for fat; whereas a woman would own the skins she wears, a sleeping skin, water gourds, perhaps a cooking pot, and the ritual objects of a gourd for fat and a decorated walking stick.

Housing is of 4 types: very small roughly constructed temporary grass huts (Fig. 3), overhanging rock caves, hollowed-out dense bushes, or completely open rocky hilltops. The type varies with the season and the locality, providing, where necessary, some protection from either rain, wind, or wild animals.

The Hadza usually are to be found in camps occupied by 1 to 15 families. These camps are unstable units and may last from 1 week to 1 month and are of constantly

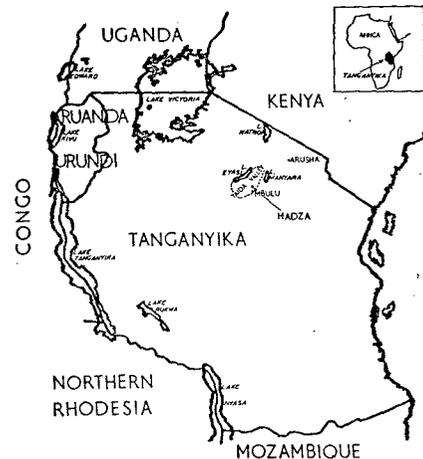


Fig. 1. Map, showing Hadza area of northern Tanganyika.

changing composition. In a camp each elementary family has its own hut or sleeping area—the small children snuggling down at night against their parents. Young unmarried women share a space; visitors and young men usually sleep outside altogether. The basic core of a camp is usually a group of matrilineally related women and their husbands and children. When the local food supply is exhausted, the camp moves, and, if necessary, the very sick and dying are left to the hyenas and vultures. In this society there is no exogamy so that there is probably considerable genetic inbreeding, but this is counterbalanced by the degree of natural selection of the fittest, which the environment and society impose.

The scattered groups of families are brought together by 3 communal activities: a nocturnal dance which emphasizes the kinship relations, gambling (for men) (Fig. 5), and the ritual communal eating, exclusively by the men, of certain parts of large animals. This meat, known as *epeme*, usually consists of the more delectable fatty portions, such as the omentum or udders, and it is believed that if eaten by the hunter alone or by a woman it would give rise to illness.²

Child rearing and marriage. At birth, the cord is cut with a knife, tied with a thread of animal tendon or tree fiber, and dressed with a mixture of soot and fat. Camp is never moved when a child has been born until after the cord has sloughed off.

Children learn the essential skills of their parents at a very early age so that it is not uncommon for a boy of 10 to be able to shoot enough birds and small game to feed himself (Fig. 6) and for such a child to leave his parents and join another band.

Marriage also takes place early, sometimes to a partner of a different age group, for example, a young man of 18 to an old widow or a girl of 13 to a much older man. This arrangement, however, is satisfactory, as with uxorial marriage the girl continues to stay with and receive help from her mother while her husband pays for her with the meat he shoots; whereas in the

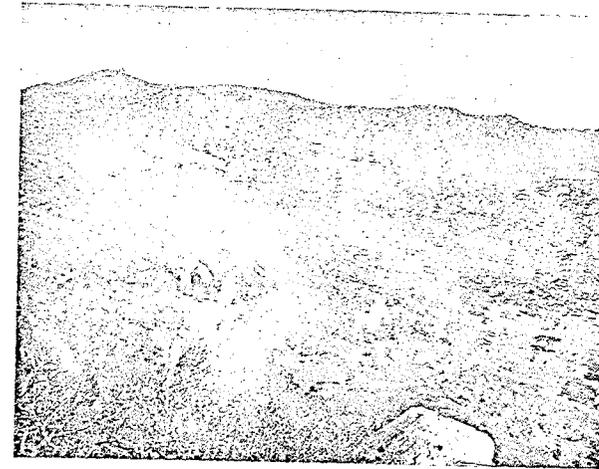


Fig. 2. Hadza area—approximately 3,000 sq. miles of roadless, tsetse-infested, savannah bush.

other case the young man goes to live with a mature and capable woman who can cook for him.

Diet. Food, including meat and yams, is mostly barbecued, and only older women are permitted to have cooking pots in which they boil meat (Fig. 7). Wild fruits and berries are eaten raw—seeds and all in great quantities so that the stools have a unique appearance. The wide variety of edible indigenous fruits and berries, unfamiliar to the Western observer, is emphasized by Carr's³ listing from Rhodesia.

The diet of the 2 sexes differs greatly as much of the food is eaten as soon as it is obtained—the men eating on the spot small animals or carrion. As all over the world, although most available foods (including baboon, vulture, and hyena) are eaten, a few items are not taken, for example termites, blood, and tortoises.

Change is being introduced already into the Hadza diet in the form of maize meal, which is being obtained in increasing amounts from the intrusive camps of laborers clearing edges of tree-covered savannah as a part of government-planned tsetse eradication. No form of alcoholic drink is prepared or bartered from the neighbors, although hashish and tobacco are smoked to the point of intoxication by means of

straight, cigar-shaped, home-carved stone pipes.

Infant feeding. Permissive breast feeding is the mainstay of infant feeding. This is prolonged until another pregnancy, and family spacing is ensured by a proscription of intercourse for many months after childbirth. Eventual cessation of breast feeding may be enforced by painting the breast with various bitter herbal concoctions.

Rendered soft fat, as from the zebra, and bone marrow, both raw and cooked, are introduced in the early months followed by a thin gruelliike mixture made of the uncooked powder, or the ground seeds, of th



Fig. 3. Hadza encampment, showing family group and typical grass huts.

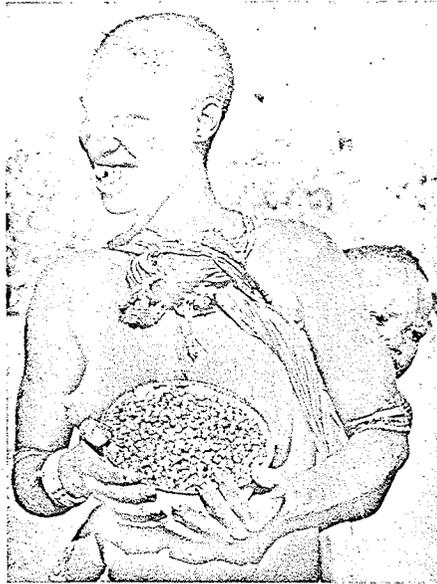


Fig. 4. Hadza mother with bowl of wild berries (probably *Lannea discolor*). Note healthy, dark-colored hair of child on her back.

baobab fruit* (*Adansonia digitata*) mixed with water (Fig. 8). Honey will also be given.

When the infant has 2 to 4 teeth, pre-chewed meat will be fed by the mother, and by the age of about 18 months the full adult range of foods will be consumed.

SURVEY METHOD

The survey was intended to assess the child health situation among the Hadza with special reference to the more important tropical pediatric problems, including protein-calorie malnutrition of early childhood⁵ and parasitic infestations. It also forms part of a larger over-all plan in progress to study patterns of child health in the different ecologic settings which East Africa provides in such profusion as to constitute almost a natural laboratory of child rearing techniques.

*Carr has drawn attention to the high ascorbic acid content⁴ (about 350 mg. per 100 Gm.) of the powder found in the ripe baobab pod.

Because of their nomadic life in this large area of completely roadless bush, the initial problem was of contacting sufficient mobile encampments to permit examination of an adequate sample of children, and this was only possible because one of the writers (J. W.) had lived with the Hadza for the previous 2 years and had mastered their language and gained their confidence. At each camp an initial period was spent in reassurance and establishing rapport by the use of the classical gifts of beads, tobacco, bangles, and matches. Following this, all children up to about 11 years of age were examined clinically, following a check-off schedule of certain more obvious predefined physical signs and syndromes, which has been described elsewhere.^{6, 7}



Fig. 5. Hadza men gambling for arrows by throwing discs of wood against trunk of baobab tree. Note fine physique.



Fig. 6. Hadza boys practicing archery. At this age, they can shoot birds or buck.



Fig. 7. Family cooking scene, showing senior woman allowed to own pot and boil meat, in this case zebra.

A thick blood film was taken and stained with Giemsa for malaria parasites. A small sample of stool was removed with an anal glass tube and then preserved in 10 per cent formol saline and examined later. Infants and toddlers were weighed with a portable spring scale.

RESULTS

In all, 62 children (37 male and 25 female) were examined. Five were infants under 1 year of age, 23 were in the "preschool age group," and 34 were "school-age" children.

Nutritional syndromes. The clinical nutritional status of all the children was good by tropical standards; in particular, the syndromes of kwashiorkor and nutritional marasmus, rickets, infantile scurvy, and vitamin B deficiency syndromes were not seen.

Nutritional indicators. No edema, hypochromotrichia, angular stomatitis, follicular hyperkeratosis, or pellagra rash was seen. However, Bitot's spots were found in 13

per cent of "preschool age" children and 17.3 per cent of older children.

The short stature of the adults made apparent that standards of weight from the other ethnic groups would not apply, and this fact together with the small number involved and extreme uncertainty about ages have led us to omit the weights. Nevertheless, there were no obviously clinically underweight children and poor musculature was not seen. In addition, there was no clinical evidence of anemia.

Parasites.

Malaria. In children of all age group only 3 had an enlarged spleen, giving spleen rate of 6.4 per cent. Of the blood films taken from all children, 11 were positive for *Plasmodium falciparum* malaria, for *Pl. malariae*, and 2 for both infections at the same time. The over-all parasite rate was 27 per cent.

Intestinal parasites. 56 stools were examined and *Taenia* ova were found in 4 and *Giardia* cysts in 3.

Miscellaneous findings. Thirty per cent of



Fig. 8. Hadza mother feeding infant with baobab gruel from a gourd. Note child's dark healthy hair.

the children had conjunctivitis; one had corneal scarring. All age groups were involved equally.

Thirteen children had their incisors markedly worn down, presumably from gnawing meat and bones. Only 2 had caries, while 2 showed obvious dental fluorosis, which was also noticed in adults. Two thirds of the children examined had medicinal incisions indicating past indigenous treatments—the commonest sites being the chest, the abdomen, and the face.

The following miscellaneous conditions were also noted: purulent nasal discharge, 6; umbilical hernia, 2; miliaria rubra, 2; skin sores, 2; otitis media, 1; and scalp ringworm, 1.

DISCUSSION

Although the number of children seen may seem small, it probably represents roughly a 25 per cent sample of the whole Hadza child population, and, as such, it gives an indication of the disease pattern at one particular season of the year. Although this tribe lives a life which most people would regard as extremely primitive, the striking feature on closer acquaintance is the remarkable adjustment that they have achieved with their environment. They have as yet built up none of the additional hazards which urbanizing communities in Africa⁸ and elsewhere have of housing and crowding together of unrelated people, over-refined foodstuffs, bottle feeding,⁹ ill-fitting clothing, ill-kept latrines, and insect-breeding water receptacles.

The main findings were the good health of the children in general, at least at the time of the survey, which was carried out during the dry season. In particular, the absence of obvious malnutrition* and anemia were probably related to both the absence of such intestinal helminths as the hookworm and roundworm and the excellent infant feeding pattern, based on prolonged breast feeding and the introduction

of animal protein in the second 6 months of life in the shape of bone marrow and pre-chewed meat. The absence of hypochromotrichia was in striking contrast to the children of the much more sophisticated Baganda, who are reared largely on carbohydrate foods.¹⁰

The high incidence of conjunctivitis (30 per cent) may be related to the dusty environment, lack of water during the dry season, and to the constant smoke from the cooking fires. Similarly, the Bitot's spots found in these children may also represent the end result of chronic conjunctival irritation and trauma rather than reflecting any inadequacy of vitamin A intake.¹¹

These children showed a comparatively low degree of malarial infection as compared with many tropical African communities. Even more striking was the absence of *Ascaris lumbricoides* and *Ancylostoma duodenale*, probably in part related to their mobile nomadic existence which results in little opportunity for heavy fecal contamination of the domestic environment. Tapeworm infections would be expected in a meat-eating group such as the Hadza whose principal method of cooking is lightly barbecuing on the hot ashes. However, the actual intermediate host is uncertain, wart-hog being the most likely.

The dental condition of Hadza children showed the worn incisors and low incidence of caries (4 per cent) expected with a diet composed of tough, fibrous vegetables and meat, containing no overmilled flour or sugar of any sort. Two children showed advanced dental fluorosis, as did numerous adults, presumably indicating a high fluoride content in water in the drinking pools used.

It is of interest that a field study carried out by Bronte-Stewart and colleagues¹ among the ecologically similar Kung Bushmen of Southwest Africa showed very similar findings in relation to good general nutrition, eye infection, and worn teeth.

The Hadza people of northern Tanganyika are one of the few remaining groups in the world dependent upon hunting and food

gathering. Their mode of life, and particularly their methods of infant feeding, probably represent the way Man has existed for the major part of his existence prior to the historically recent development of agriculture, domestication of animals and commercial city dwelling. The future of the Hadza people, and of their children, is ominous. Government-sponsored policy, aimed at benefiting the country as a whole, is to extend tsetse fly control into this area by the progressive clearing of trees. This enables the more numerous surrounding tribes to move in with their cattle, but will ultimately reduce the land available to the Hadza to less than is essential for their widely wandering, hunting, and food gathering activities. It seems, then, as if the Hadza mode of life will change in the next decade, probably in the direction of cultivation. If this occurs, it is probable that the development of static, insanitary villages with mainly carbohydrate crops may tend to result in less healthy children than at present.

Our thanks are due Mr. M. B. Ronaldson, District Commissioner, and Dr. W. Thurston, District Medical Officer, Mbulu, for their most valuable assistance.

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*In addition, during a 2-year period living with the Hadza, no case of kwashiorkor was seen (J. W.).