Nutrition, Growth and Childhood Obesity: A Viewpoint

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Introduction

The basic science of Paediatrics is growth and development. Growth simply means change in size of the body as a whole or of its separate parts. Development on the other hand covers other aspects of differentiation of forms but principally involves change of function.

To achieve one's biological potential, several factors are involved, of which nutrition is one. The latter of course may reflect primarily socioeconomic realities. Genetic factors are sometimes thought of as the final limits to biological potential but these are intimately interwoven with the environment. Physical trauma may affect growth and development. This may be pre or post natal, due to chemicals or infections.

Social and emotional factors, for example the position of a child in the family, quality of interaction of the child with siblings, parents and other caretakers, personal concerns and needs of the parents and child rearing patterns of the parents or the community are also important factors in child development. Politics, religion and culture are closely related. It is the political life of any community that provides the arena in which public priorities are set, including those which may have profound effects upon children. The experience of each child is unique and the patterns of development may be profoundly different for individual children within the broad limits that designate normality.

Nutritional Status

In order to appreciate the effect of nutrition on growth one needs to be familiar with how to assess nutritional status. Perhaps the oldest form of assessment is the "calorie count" or calculation of any food intake. But nutrient deficiency can also be derived not only from altered intake but also from reduced digestion/absorption, excessive wastage, impaired utilization or increased requirements for nutrients.

Monitoring dietary intake can be important in the nutritional management of a child at risk of malnutrition and for determining whether the prescribed food intake is being met, but it does not measure nutritional status.

Complete nutritional assessment of the individual must integrate several approaches all of which provide pertinent data regarding the patient's present and future nutritional state. Not only the medical and nutritional history are important but proper physical examination, including anthropometric measurements and growth assessments as well as biochemical and metabolic changes. These will provide a more complete picture.

A normal growth pattern is not a guarantee of overall health, but the child with a typical pattern of growth failure is more likely to have disease or some underlying cause. A healthy child on a routine visit to the doctor requires only a measurement of height, weight and head circumference along with a routine history and physical examination. A routine history should include a nutritional history with questions regarding familial attitudes towards "junk foods", a balanced diet and the major food groups. When these screening tools raise doubt about the adequacy of the child's nutritional state, more rigorous assessment should be undertaken.

Anthropometry, is essential for the proper clinical evaluation of growth and nutritional status. Carefully performed measurements plotted on a standardized graph are used to compare an individual child's growth rate with established norms. When interpreting anthropometric data, it is critical to recognize that adverse change is a relatively late consequence of nutritional insult. The evolution of nutritional depletion in an individual evolves along a sequential course, beginning with desaturation of tissue stores with associated deficits in function. Only later, in the final stages of depletion, do physical signs and clinical symptoms become manifest.

The most commonly used anthropometric measurements are weight, heights, head-circumference, and weight for height. For the average healthy child, the expected steady increase in these parameters is reassuring and sufficiently indicative of normal growth and nutritional status.

Length or height is a better indicator of growth than weight. Persistent growth of the brain and skeletal system is expected to occur even at the expense of the rest of the body mass. In 1956 Gomez classified malnutrition on the basis of deficit of weight for age using the 50th percentile of appropriate reference data. This classification failed to distinguish stunting from wasting. The expected weight for height index is particularly

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useful in identifying a child who is acutely malnourished. It can help to distinguish the chronically malnourished or "stunted" child from the acutely undernourished or "wasted" child.

The child with a normal height who suffers from acute malnutrition will be identified by a less-than-expected weight for height. Yet the undernourished child suffering from chronic undernutrition can have an otherwise acceptable weight for height if he or she displays poor linear growth along with minimal weight gain. The best gross indicator of a child's long-term nutritional status is not how big he is but how fast he is growing. Growth increment is of greater value than size alone. Growth velocity is an especially sensitive indicator during the period of expected rapid growth at adolescence.

For the child whose nutritional status requires closer attention, measurements of mid-upper arm circumference and skinfold thickness are useful. The subcutaneous fatness reflected by skinfold thickness and the size of the muscle mass, estimated by arm circumference, are indirect indicators of calorie and protein reserve. Tricep skinfold thickness is of more value in assessing obesity than undernutrition.

Undernutrition and Growth

Effect of nutrition on growth will depend to a degree on the duration and type of deficiency or excess, and the preexisting health status of the individual. As an indicator of past nutritional status, growth provides a cumulative record of the nutritional adequency of the diet. With the exception of severe protein-energy malnutrition, growth is less useful as a measure of short term, nutrient specific deficiencies.

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In terms of undernutrition, protein-energy malnutrition (PEM) is the classical consequence. It is undoubtedly the most prevalent illness of infants and children in the developing world. The major antecedents of PEM in these settings are inadequate food intake, recurrent diarrhea and repeated episodes of infection. While once thought to be a distinct condition, kwashiorkor is frequently superimposed on marasmus, and overlap between these two clinical endpoints of PEM is common.

Marasmus results when energy intake is insufficient to meet energy needs, even if intakes of other nutrients are fully adequate. This rarely occurs. More commonly its a "balanced starvation". The initial response to a mild degree of energy inadequacy is reduced weight gain. Linear growth may continue at the expense of catabolization of fat stores.

With more severe or prolonged deficits, both weight gain and linear growth slow or cease. Frank weight loss ensues as fat stores are consumed and subsequently as muscle and visceral proteins are catabolized to meet energy needs. Short episodes of starvation result in a child who is wasted, i.e. has low weight for normal height. In chronic mild energy deprivation, the child's growth rate slows. Height is substandard but weight for height may be low normal. In the more chronically deprived child, height is low and weight for height is also low. Thus the child is both wasted and stunted.

Kwashiorkor classically has been thought of as purely protein deficiency. Although this is a useful model it is very simplistic. Frequently it is superimposed on a child with marasmus. The initial response to a marginal decrease of either quantity or quality of protein in the diet is a slowing of the growth rate. In its severe form the child is listless, apathetic, edematous and has a distended abdomen secondary to poor muscle tone plus or minus ascites.

What happens to these undernourished children, given proper support, depends to a large extent on the age of these individuals. Catchup growth and ultimately normal status are possible even after severe malnutrition in infancy. The problem is more vexing in the older growth retarded child who presents closer to puberty and who has a limited number of years left during which catchup can occur. Even with optimal therapy some of these children will not achieve stature above the 5th percentile regardless of their genetic potential.

As to how much nutrition affects development, this has been a subject of controversy. As mentioned earlier other factors are also in operation. Earlier studies suggested a strong association between malnutrition and poor mental development. However, these studies failed to separate nutritional from environmental influences. Children who experienced undernutrition as infants but who were subsequently reared in favourable social environments demonstrated no measurable long term deficits in mental development. The development delay is typically uneven. Gross motor and speech delays are usually most severe. Fine motor and visual areas are spared and cognitive assessments are distorted by a significantly depressed affect.

In terms of short-term fasting, the positive effect of good nutrition on a child's ability to learn is generally accepted as a basic nutritional dogma and that breakfast is believed to be an especially important meal. Although this has been demonstrated not to be the case, new evidence is indicating that short-term fasting may indeed affect educational performance and that there may be educational benefits of feeding children in the school.

Childhood Obesity

Given the current situation in Tonga, childhood obesity is a "problem" that needs to be addressed now. Although there is no good study done among Tongan School children to show that obesity is a problem, the National Nutrition survey in 1986 showed that obesity is a major problem among men and women. Obesity in childhood is associated with an increased risk of becoming an obese adult. Furthermore, adult obesity is associated with diseases like ischaemic heart disease, hypertension, diabetes mellitus, and hyperlipidemia, with an increased mortality and morbidity risk. Excess weight also causes disability by exacerbating osteoarthritis, increasing liability to post-operative complications, and by contributing to emotional and social problems.

Obesity is an enlargement of adipose tissue out of proportion to other body tissues. However, this is not a very practical defination. Given an experienced trained observer, its not difficult to tell whether there is excess fat or muscle bulk or both. Some have used weight greater than 20% of standard as their criteria. Pitfalls here include error in differentiating between excess muscle or adipose. Some arbitrarily take what is above the 97th percentile on growth chart as being obese. Skinfold thickness is useful for assessing fatness but difficult to apply in extreme obesity.

Several studies have now shown that the risk of an obese child becoming an obese adult is high, varying from 2.3 - 6.3 times more than the non-obese child. The percentage of obese children becoming obese adults varies from 14 and 41 to about 70 percent as the children go from 6 to 7 years to 10 to 13 years of age, respectively. Thus the older the child who is obese, the more probably this obese child will become an obese adult.

Aetiology

Obesity is due to an increase in the storage of fat secondary to excess food intake more than body requirements. There are several factors that influence the balance of food and body needs.

It is fairly well accepted that there is a genetic component but there have been problems in separating what is due to environmental influence. Familial influence is of major importance. The relative risk for a boy or girl being obese if all the other family members were obese was 8.6 and 4.7 for boys and girls, respectively. Prevalence of obesity is also said to be inversely related to family size. Obese infants are more likely to become obese adults if their parents are obese than if their parents are thin.

Fifty-one percent of obese infants with obese parents compared with 20 percent of obese infants with thin parents became obese adults. Non-obese infants were at lower risk of becoming obese adults, whether or not they had obese parents, since less than 20 percent of all non-obese children became obese adults. Some of the mechanisms for these effects include modeling, food and exercise availability, stimulus control and reinforcement control.

The effect of socioeconomic factors is complex. Globally it is said that fatness follows the Gross National Product and per capital income, i.e. fattest nations are the richest and vice versa. Now in affluent countries obesity is prevalent in lower socioeconomic class. This also seems to be the case in developing countries.

Some people feel that the appetite regulating system is insensitive or perhaps conditioned in such a way that it is difficult to satisfy these obese individuals. Whether early introduction of solids contributes to later obesity remains a controversial issue.

Energy intake and expenditure play a big role in the etiology of obesity. Excess carbohydrate, which is cheap and readily available is the biggest offender of the three major food groups. Those who eat 5-7 meals a day are less obese than those having 3 meals, even with those who miss out on breakfast but make up for it in the last meal of the day just before bedtime. Despite these variations, it is important to recognize that individual energy requirements also vary.

Energy output theoretically should be close to that of energy input. One's lifestyle and physical activity is of great importance and there is often a vicious cycle whereby physical inactivity may cause obesity which then further restricts activity. Similarly emotional problems can cause obesity which leads on to more emotional problems because of less attractiveness to the opposite sex, for example. For some obese children excessive eating may be a way of dealing with their anxiety or frustrations. Some mothers may feel more adequate by maintaining her children as babies by continuing to "feed" them in order to foster that relationship.

Treatment of Childhood Obesity

A comprehensive program should have three factors:

1. Promotion of a diet that will produce weight loss, be easy to adhere to, and will promote growth.
2. Incorporation of an exercise program that promotes energy expenditure, and is also easy to adhere to.
3. Comprehensive training of parents and children. The use of behavioral treatment procedures for train-

ing parents and children to make habit changes ensures that the diet and exercise information can be translated into action.

These three-prong family based treatment procedures constitute the treatment programme of the child weight control clinic at the University of Pittsburgh School of Medicine. Details of each aspect will not be dealt with but it will suffice to mention a few points.

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The traffic-light diet or food pyramid categorizing food into three groups is of particular value. Where its GO *(green)* you eat as much as you like, approach with CAUTION *(yellow)* and eat in moderate amounts only and STOP *(red)*, you do not eat.

With the exercise programme, points were allocated for a variety of exercises that will give rise to certain energy expenditure. Thus in a week, one's goal is to achieve a certain score. It is important to point out that the negative balance produced by exercise is significantly less than that produced by diet.

One of the cornerstones of treatment of childhood obesity is behaviour modification. It has been shown that comparing behaviour modification with a health education group the relative weight change after 5 months was 2.7 times for the former versus the latter. Positive reinforcement is an important component of a weight control programme and children in families that provided a programme that included both positive and negative reinforcement do better than children in families that provided only negative reinforcement procedures.

There are four components of this behaviour modification. Firstly participants are given information on a modular format with exercises to work through. In the second component, families self-monitor calorie intake, exercise and weight. In the third aspect of this programme, both parents and children are taught to be models for eating and exercises are prescribed for other family members. They also help by praising and positively support other family members for habit change. The last component is contracting where both parents and child plus the therapist agree on goals and a reward once the contracting condition is fulfilled.

The result of this study showed the clear superiority of the parent and child over the child alone and non-specific control group. In the first 21 months there were no significant differences across the 3 groups. However, after 5 years, only the child and parent group maintained their relative weight change.

Parents showed significant differences only after 8 months of treatment. At 21 and 60 months there was no difference in the parent groups.

That is, modeling is not the only operating factor for this discrepancy over time, suggesting that parents may be able to maintain child behaviour change while theirs is deteriorating or that the children may learn to self-regulate their own behaviour despite the parents' inappropriate modeling.

Realizing that there is a growing body of evidence that has highlighted important risk factors for the development of obesity in children plus the fact that childhood obesity is a problem that places a child at great risk of becoming an obese adult with its associated disease, every effort should be made to address and prevent this problem early, knowing that treatment methods now can produce significant and longer lasting effects on childhood weight status.

Conclusion

Nutrition and the many factors affecting food use and supply are important factors in development. Both undernutrition and obesity among children are important problems in Pacific countries like Tonga. The solutions lie as much in the culture, economics and politics as in the health services.

Who then is responsible for the solution of undernutrition, growth and childhood obesity has remained one of the unsolved mysteries of the Pacific!

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