

NUTRITION AND REPRODUCTION

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Abstract

The general health status including reproductive health of every adult of reproductive age alive today has already been determined to a large extent by the quality of the nutritional environment from his or her conception through infancy, childhood and adolescence to his or her present age. The effects of intrauterine malnutrition can persist throughout life. Poor feeding practices during the first 2 years of life have immediate and often long-term negative consequences on growth and development. Poor nutrition during the growing years affects growth and development potential, while nutritional stress during adolescence and the reproductive years affects the health of especially women and consequently, the next generation. There are critical periods at the different stages in the life cycle, during which specific nutrient deprivations result in irreversible damage, which limit the full growth and functional potential of the individual. This paper discusses the role of nutrition in human development from conception to reproductive age, highlighting the negative effects of nutritional deprivation during the process. Since life begins at conception, and the female is responsible for ensuring that a full-term, healthy, viable infant is born and adequately fed to maturity, attention will be drawn to recommended feeding and dietary needs of women that would break the cycle of poor health and nutrition that passes on from generation to generation.

Introduction

Life begins at conception and despite the fact that there are some aspects of fetal and newborn health which are beyond the parents' control, there is much evidence to show that good nutrition during the childbearing years for both females and males significantly determines the baby's health and future (Wardlaw et al. 1994). As Sizer and Whitney (1997) put it: "Our nutrition is not personal as we normally think for it affects not only our own lives but that of generations to be born".

For example, some recent research findings suggest that inadequate vitamin and mineral intake in the months before a woman conceives and during the first month's of pregnancy may lead to birth defects (Butterworth 1993). The LINKAGES Project report (2001) on essential health sector actions to improve maternal nutrition in Africa has pointed out that maternal malnutrition prior to and during pregnancy causes intrauterine growth retardation, leading to two thirds of low birth weight babies in developing countries whose neonatal mortality rates are two or three times higher than normal weight babies. Researchers have associated low levels of folic acid in men with decreased sperm count and sperm density, which affects reproductive performance. Again men with low levels of vitamin C have more genetic damage in their sperms, which can cause birth defects in babies (Sanders 2001). Lifelong dietary habits are therefore important in determining reproductive health and performance.

Since the female is responsible for ensuring that a full-term healthy, viable infant is born and adequately nursed, maternal nutrition should be properly focused during all phases of reproductive life, to break the cycle of poor health and nutrition that passes on from generation to generation. The focus becomes more urgent because according to McGuire and Popkin (1990), in most developing countries, women spend a large proportion of their reproductive years

pregnant, lactating or both. Women in Africa are pregnant or lactating, on average, 30 to 48 percent of the time between the ages of 15 and 45 years.

The need to focus on women's nutrition throughout the reproductive years has evidence in history of the effect of maternal malnutrition on the course and outcome of pregnancy. Many studies have suggested that the better the state of a mother's nutrition before or at the time of conception, the greater the chance of normal pregnancy leading to the birth of a healthy baby (Williams 1993).

Guthrie (1989) and Wardlaw et al. (1994) have recounted early research supporting the importance of diet preceding pregnancy. They have illustrated with data on babies born during a period of wartime starvation. Babies who were conceived before the hunger broke out by mothers whose previous diets were good were shorter and lighter than babies born to mothers' whose diets were adequate throughout pregnancy.

Moreover, among the babies conceived before the hunger, there were fewer stillbirths, premature births, and congenital mal-formations compared to babies conceived during the hunger period. A reduced rate of conception also occurred during the hunger period. However, birth weights, infant health and the numbers of new pregnancies quickly returned to pre-war levels when the hunger came to an end.

On the basis of data from animal studies and cross country comparisons, poor maternal nutrition has been implicated as one of the key "adverse environmental influences in utero," which could lead to compromised fetal and placental growth and adverse long term consequences (Baker 1992).

Guthrie (1989) has also referred to studies which have showed that mothers on good diets experience few complications during pregnancy and give birth to infants with a greater chance of survival. For example, Thomson and Billewicz (1963) reported decades ago, that the incidence of premature births, caesarean section, and prenatal deaths increased as the dietary rating of maternal health fell, as illustrated in Table 1.

Table 1
Incidence of Obstetric Abnormalities by Maternal Health and Physique

Abnormality	Maternal Health and Physique			
	V. good	Good	Fair	Poor/V. poor
Prematurity (%)	5.1	6.4	10.4	12.1
Caesarean Section (%)	2.7	3.5	4.2	5.4
Prenatal deaths per 1000 births	26.9	29.2	44.8	62.8

Source: Guthrie (1993)

After birth, the new born infant faces the challenge of attaining physical maturation during which the body functions are fully developed including sexual maturation and reproductive capacity. In this regard, good feeding providing adequate nourishment ought to receive attention during infancy, childhood and adolescence to prevent the often long-term negative consequences of malnutrition on growth and development.

This paper presents the role of nutrition in human development with emphasis on prenatal development during pregnancy, lactation and through the growing years to adolescence, when reproductive age is attained. The negative effects of nutritional deprivation are highlighted while attention is drawn to recommended dietary and feeding needs at the various stages.

The Role of Nutrition in Pregnancy and Fetal Development

Nutrition is one key to a successful pregnancy (National Academy of Sciences, 1990). Indeed, the nutrition of the woman who is pregnant or who intends to be will be critical to the health of her child in years to come. As such, before she becomes pregnant, a woman must be well nourished because although most women are often not aware they are pregnant during the first few weeks, the embryo undergoes significant developmental changes that depend on the mother's prior nutritional status (Wardlaw et al. 1994; Sizer & Whitney 1997). Fertilization or conception is followed by rapid cell division and by two weeks after fertilization, the ball of cells is implanted in the uterus. From 2 to 8 weeks, during which critical cell differentiation occurs to develop the embryo, demands for abundant maternal nutrient base is crucial for such rapid development. By the end of the 7th or 8th week the embryo can be identified as human with a complete central nervous system, a beating heart and a fully formed digestive system. From 8 to 40 weeks, the fetus grows rapidly to full form.

Table 2

Recommended Dietary Allowances (RDA) of Some Selected Nutrients for Pregnancy and Lactation (National Research Council, 1989 Revision)

	Non pregnant girl		Non pregnant woman	During pregnancy All ages	Lactation	
Nutrients	11-14yr 46 kg 101 lb	15-18yr 55 kg 120 lb	25 yr 63 kg 138 lb		(600 ml/dy) First 6 months	(750ml/dy) Second 6 months
Calories	2200	2200	2200	No change in the first trimester: add 300 kcal/day for second and third trimesters	2840	2710
Protein (g)	46	44	50	Add 10 g/day	Add 15 g/day	Add 12 g/day
Calcium (mg)	1200	1200	800	1200 mg throughout		
Iron (mg)	15	15	15	30 mg throughout	15	15
Vitamin A (µg RE)	800	800	800	800µg (RE throughout)	1300	1200
Thiamin (mg)	1.1	1.1	1.1	1.5 mg throughout	1.6 mg throughout	
Riboflavin	1.3	1.3	1.3	1.6 mg throughout	1.8	1.7
Niacin (mg NE)	15	15	15	17 mg NE throughout	20 mg NE throughout	
Ascorbic acid (mg)	50	60	60	70 mg throughout	95	90
Vitamin D (µg)	10	10	5	10 µg throughout	10 µg throughout	

Source: Williams (1993).

Each organ grows with its own characteristic pattern and timing, and depends most on its supply of nutrients during its own intensive growth period known as critical period. Events during the critical period can occur only at that time and at no other. Therefore, the nutrients and other conditions needed during this period must be supplied on time if the organ is to reach its full potential. If an organ is limited during a critical period, recovery is impossible.

The first trimester is an especially critical period when poor nutrition can result in birth defects. For example, malnutrition prior to pregnancy could lead to failure of implantation or cause abnormalities resulting in loss of the zygote even before the woman knows she is pregnant. Another example is that since the heart and brain are well developed at 14 weeks, the lungs 10 weeks later, early malnutrition could impair the heart and brain and late malnutrition could impair the lungs. Thus, early malnutrition often does irreversible damage, although this may not become fully apparent until maturity and may never be attributed to events of pregnancy. The energy and nutrient requirements of pregnancy far exceed those of the non-pregnant woman (see Table 2).

The mother's diet must supply all the nutritional demands of the fetus and her own body. For micronutrients, vitamin/mineral supplements are needed where the diet cannot supply them. The energy increment is needed to spare protein for tissue building, to sustain rapid fetal growth, to ensure maternal fat storage necessary to provide energy reserves for labour and delivery and for maintaining lactation after birth. Appropriate weight gain during pregnancy indicates whether sufficient calories are being provided. Adequate weight gain for a mother is one of the best predictors of pregnancy outcome. Her diet should allow for about 2 to 4 pounds (0.9 to 1.8 kg) of weight gain during the 1st trimester, and then subsequent gain of $\frac{3}{4}$ to 1 pound (0.3 to 0.5 kg) weekly during the second and third trimesters.

It is recommended that setting weight gain goals with the pregnant woman must be according to her pre-pregnancy Body Mass Index (BMI or weight for height ratio), pregnant nutritional status, and whether or not she is carrying multiple fetuses (National Academy of Sciences 1990).

Table 3 gives the recommended weight gain in pregnancy based on pre-pregnancy BMI.

Table 3
Recommended Weight Gain in Pregnancy Based on Pre-pregnancy Body Mass Index (BMI)

<u>Pre-Pregnancy Weight-for-Height</u>	<u>Recommended Total Gain (Pound)</u>
* Low (BMI of < 19.8) Underweight Women	28 - 40
* Normal (BMI of 19.8 to 26.0) Normal weight women	25 - 35
* High (BMI of > 26.0 to 29.0) Overweight women	15 - 25
* Obese women (BMI of 29.0)	≤ 15

Source: National Academy of Sciences (1990).

Total weight gain goal normally averages 25 to 35 pounds (11.5 to 16 kg) which has been shown to yield optimal health for both fetus and mother. For adolescent mothers, it is recommended that they strive for the upper end of the range and a woman carrying twins should target a weight of 35 to 45 lbs (16 to 20.5 kg). Mothers who fail to gain weight are likely to deliver infants of low birth weights (<5 $\frac{1}{2}$ lbs) or 2,500 g) who are nearly forty times likely to die in the first year of life than normal weight infants. The LINKAGES Project (2001) has reported that many African women consume less than the recommended allowance for calories and that between 5 to 20% of women in various African countries are underweight. In Ghana, the mean BMI is 22.1 and that one in nine women in Ghana fall below the cut-off 18.5, indicating that the level of chronic energy deficiency in Ghana is relatively high (GSS and MI, 1999). In 12 out of 17 African countries, 10% or more babies are born with low birth weight, a reflection of poor

weight gain during pregnancy. According to Ghana Health Service data, (GHS, 2002) the low birth weight rate for 2002 was 10%, an increase of 17% over the 2001 figure of 8.3%. Failure to gain weight during the second trimester is also likely to result in premature deliveries and toxemia, which when severe can cause maternal death.

The growth of the fetus makes heavy demands for protein. Besides, protein is needed for the enlargement of the uterus, mammary glands, and placenta. Protein is also needed for the increased maternal circulating blood volume and for the formation of amniotic fluid. Protein intake influences birth length within the limits of heredity. Taller babies being born to mothers with high – protein diets than those with low-protein diets.

Protein restriction during fetal life has been associated with a decrease in the number of cells in tissues at the time of birth, a situation particularly serious in the case of the brain which is relatively well developed in prenatal life and may be irreversibly stunted. Brown (2000) has reported that one in 4 babies born in developing countries have intrauterine growth retardation and are at risk of mental impairment.

The incidence of abortion in early pregnancy among women on low protein diets has also been found to be almost two times as high as it is in women on high-protein diets (Guthrie, 1989).

The needs for iron, calcium and zinc increase during pregnancy. Increased iron is needed to synthesise the greater amount of haemoglobin needed and to provide liver stores for the fetus to last it for 4 to 5 months after birth. Maternal iron stores also help fortify the mother against iron losses at delivery. Severe iron deficiency anaemia in pregnancy leads to premature delivery, low birth weight babies, and increases risk of infant death in the first few weeks of life (Williams, 1993; Wardlaw et al., 1994). Anaemic women are more likely to have prolonged labour which predisposes them to sepsis and increases risk of death (Gillespie 1998).

In 12 African countries surveyed, anaemia rates among pregnant women ranged from 43% in Nigeria to 80% in Tanzania (LINKAGES, 2001) and anaemia has been found to be responsible for an estimated 20% of maternal deaths (Ross & Thomas, 1996).

Calcium increase of 40% above the RDA is needed for fetal development especially during the third trimester of growth when skeletal tissues are growing rapidly and teeth are forming. (Williams, 1993; Wardlaw et al., 1994). Adolescents have a greater requirement for calcium during pregnancy to meet the needs of the fetus and the growing mother. In pregnancy, there is need for calcium storage rather than depletion to support demands of lactation later. Low calcium intake leads to withdrawal of calcium from maternal reserves which may weaken her bones (Sizer and Whitney, 1997).

Zinc needs increase by 25% above the RDA. The extra protein foods in the diet should supply this much zinc. It is a mineral which has its most profound influence on rapidly growing tissues, therefore, its effect on reproduction is significant. Maternal zinc deficiency is clearly associated with low birth weight (Guthrie, 1989; Wardlaw et al., 1994). Zinc deficiency is suggested as a cause of central nervous system problems (Guthrie, 1989), premature rupture of membranes and pre-eclampsia (Maeda and Tanaka, 1996). Zinc deficiency has been observed in 36 to 46% of pregnant women studied in Malawi (Gibson and Huddle, 1998).

Levels of iodine that will normally prevent goitre in the non-pregnant mother prove inadequate in pregnancy leading to goitre in the mother. When a mother has goitre the chances of her offspring developing goitre are increased ten times and the incidence of cretinism (retarded growth and mental retardation) the severe form of iodine deficiency in infants rises. Adolescent girls need special attention with regards to meeting iodine needs since a deficiency could lead to development of goitre, increasing the risk of having babies who are cretins

(Guthrie, 1989). Although the introduction of iodized salt has led to a major decline in goitre, iodine deficiency still remains a problem in some African countries as pointed out by WHO/UNICEF/ICCIDD (1997) and referred to by LINKAGES (2001).

Vitamin needs generally increase and of special interest are the needs for vitamin D and folate. Vitamin D needs double to aid calcium absorption for fetal bone formation. To provide it, pregnant women should get regular exposure to sunlight. It is established that entering pregnancy without adequate folate stores pose the risk of having infants with neural tube defects, such as spina bifida - protrusion of the spinal cord through gaps in the vertebral column- (Czeizel & Dudas 1992; Sizer and Whitney 1997). The early weeks of pregnancy are a critical period for the neural tube, which develops to form the brain and the spinal cord. By the 6th week of gestation it is supposed to have closed. In severe cases, the brain may fail to develop at all, and the infant dies. More common problems include club foot, dislocated hip (which in females could in adult life cause obstetric problems), kidney disorders, curvature of the spine, mental retardation and muscle weakness (Sizer & Whitney, 1997).

It is reported that each year nearly 400,000 infants are born in the United States of America with neural tube defects, half believed to be related to inadequate maternal folate during the earliest weeks of pregnancy (Sizer & Whitney 1997).

Megaloblastic anaemia, a common type of anaemia of pregnancy results from folate deficiency. Infants born to such mothers also have this type of anaemia. Folic acid deficiency has been found to be common in pregnant women in many parts of Africa (LINKAGES 2001).

The water-soluble vitamins including vitamin C, thiamin, riboflavin and niacin are of special need during pregnancy because they are important in a number of metabolic activities related to energy production, tissue protein synthesis, and function of muscle and nerve tissues. Since they are not stored to any appreciable extent, the pregnant woman must rely on a daily intake. Vitamin C needs deserve special mention since it is essential to the formation of connective tissue and vascular systems as well as increasing absorption of iron (Williams 1993). It is worth noting that animal studies have linked lack of riboflavin on the 13th and 14th day of gestation with interference with cartilage formation, resulting in skeletal malformations (Williams 1993).

The teenage pregnant mother deserves special nutritional guidance to be able to cope with the high demands of energy and nutrients of the growing fetus superimposed on her own growth needs. As a result of malnutrition common among pregnant teenage girls, there is high incidence of stillbirths, premature deliveries of infants with low birth weight leading to higher mortality rates of babies, more congenital defects, and inadequate nutrient stores for infants to carry them through the initial period of extrauterine life. In all aspects, the malnourished teen mother is a high obstetric risk especially when the interval between menarche and conception is short (Guthrie 1989; Fraser et al. 1995).

Modification of Diet and Feeding Plan during Pregnancy

Since the mother's diet must supply all the high demands of energy and nutrients, a great burden is placed on her to increase her food intake. A woman who has good food habits and is well nourished when she becomes pregnant needs to alter her diet only by increasing intake of foods she is accustomed to. Obviously, the extra quantity of food needed cannot be incorporated in 3 regular meals. In such a case, nutritious snacks, kept relatively low in satiety value so that appetite is not decreased at regular meals must be included.

The meal plan will therefore follow a plan like this:

- | | |
|-----------------------|-------------------------|
| 1. Breakfast. | 4. Mid-afternoon snack. |
| 2. Mid-morning snack. | 5. Supper |
| 3. Lunch. | |

In essence, two important principles govern the diet of the pregnant woman:

- i. that she eats a sufficient quantity of food including a wide variety of foods and
- ii. that she eats regularly, avoiding any habits of fasting or skipping meals.

We must always remember that specific nutrients, not specific foods are required for a successful pregnancy and these nutrients are found in a wide variety of locally available foods. The LINKAGES Project (2001) has identified the following health sector actions to address nutritional needs of pregnant and lactating women so as to improve maternal nutrition in Africa.

- Adequate food intake. This can be achieved by encouraging women to increase intake during pregnancy and lactation and to counsel them to reduce energy expenditure and rest more.
- Adequate micronutrient intake by counselling mothers to diversify their diets through increased daily consumption of fruits, vegetables, animal products and fortified foods.
- Where food sources are poor or not available, consumption of micronutrient supplements must be encouraged.
- To reduce malaria infection in pregnant women in endemic areas through the use of anti-malarial curative and/or prophylactic drugs and use of insecticide-treated materials.
- Reduction of hookworm infection in pregnant women in endemic areas through preventive measures and use of prescribed drugs.
- Birth spacing of 3 years or longer by promoting optimal breast feeding (2 years or more) and promote family planning as a health and nutrition intervention, and counsel on the need for recuperative period to build energy and micronutrient stores.

Nutrition and Lactation

The responsibility of breast-feeding falls solely on the mother and as such, her dietary needs are high (Table 2) and must be met because adequate nourishment is essential to successful lactation (Sizer and Whitney 1997). A normal developing baby doubles its birth weight in about 5 to 6 months which is evidence of the demands the breast fed infant makes of the mother. Except for folate and iron needs, the energy and nutrient demands exceed those of pregnancy. As such, the diet should always be of good quality to prevent depletion of maternal tissue reserves. The need for the extra energy, protein, minerals and vitamins is to cover the cost of secreting milk, the amounts secreted in the milk, and to protect maternal tissue reserves. There is concern about the impact of lactation on the bone mineral status of the adolescent mother, which can predispose her to low bone density limiting her health throughout the reproductive years. Generally, the effect of nutritional deprivation on the lactating mother is to reduce the quantity, not the quality of the milk (Sizer and Whitney 1997).

Modification of Diet and Feeding Plan during Lactation

Like, the pregnant woman, the extra quantity of food needed to supply the lactating mother's high nutrient requirements cannot be incorporated in 3 regular meals. The same recommended meal pattern for the pregnant woman would be appropriate for the lactating mother too. That is, by including nutritious snacks, ensuring that meals are regular, diversified and of sufficient quantities. The suggestions made by LINKAGES Project (2001) already given under the plan for pregnant women are also applicable to the lactating mother.

An adequate diet during pregnancy is one of the best bases for the initiation of breast-feeding. If the woman has gained weight properly during pregnancy, about 1/3 of the extra needed energy can be met from maternal fat stores over a 100 day period of lactation (Wardlaw et al. 1994). Boyne (1992) points out that breast-feeding allows for gradual loss of extra body fat accumulated

during pregnancy especially if breast-feeding is continued for 6 months or more. This shows how practical the link between pregnancy and breast-feeding is.

Nutrition and the Growing Years

Infancy: 0-24 months

This is a period of very rapid growth during which an adequately nourished child doubles his birth weight by 6 months and triples it by one year. The current recommended approach to infant feeding is to exclusively breast-feed for the first six months before supplementary foods and water are introduced.

The United States National Academy of Sciences confirms that human milk is tailored to meet infant nutritional needs for the first 4 to 6 months of life. Wardlaw et al. (1994) have stressed that human milk allows for adequate hydration of the infant, provided the baby is exclusively breast-fed. This assertion should allay the fears of mothers who do not practice exclusive breast-feeding for fear that their babies will be dehydrated. In Ghana, the rates of exclusive breastfeeding are still low. In 2001, the rates at four months and six months were 35% and 17% respectively. It is however hoped that by the end of 2003, the rates would have increased to 40% and 25% respectively (GHS, 2002). There are many established nutritional, immunologic, physiologic, psychological and practical advantages to breast feeding (Williams 1993). For example, human milk changes to meet the changing nutrient and energy needs of the growing infant; since the mother transfers certain immune properties in her milk to her nursing infant, the child experiences fewer infections. The infant is also not exposed to infectious organisms in the environment that contaminate milk preparations and equipment for bottle feeding, especially as occurs in poor living conditions. Fewer allergies and intolerances occur with breast-feeding compared with using cow's milk which contains a number of allergy-causing proteins that human milk does not have. Human milk is easier to digest, since it forms a softer curd for the infant to digest. Moreover breast milk is convenient and economical, since the milk is always ready and sterile, and the mother is free from the time and expense involved in buying and preparing formula. Furthermore, psychological bonding occurs as mother and child relate to one another during feeding. Breast-feeding must be on demand.

Since breast-milk provides all the essential energy and nutrients in quantities required for optimal growth, there is no nutritional need for introducing solid foods to infants before 4 – 6 months.

The need for introducing solid foods is determined by:

- nutritional needs,
- physiological readiness and
- physical maturity.

By 6 months milk alone will not supply all the nutritional needs to support the actively growing infant. At the same time, the enzymes for digesting complex carbohydrates and protein besides those found in milk will be present. The kidneys would then be mature enough to handle high-protein diets. Physically, the infants jaws would have matured enough, the swallowing technique would have developed and with increase in saliva production, semi-solid foods would be easier to swallow.

It is therefore the right time to introduce gradually semi-solid and solid foods to the baby.

Guide to Introducing Solid Foods

The sequence of introduction of semi-solid and solid foods could be as follows:

1. Introduce fruit juices to supply vitamin C.
2. Introduce the local cereals as porridge, one at a time so that the child will develop

the taste for each of their distinctive flavours. Cereals will contribute energy, iron, riboflavin and niacin.

3. Introduce well-ripe whole fruits, finely mashed at first.
4. Introduce mildly flavoured vegetables, smoothly mashed. The vegetables could be served as stew with softly mashed cereal preparation. This is when some fat or oil could be introduced to provide a concentrated energy source to reduce the bulk of the weaning meal. Fruits and vegetables supply the infant's needs for a variety of vitamins and minerals.
5. Introduce animal products like eggs, meat, poultry, liver and fish to provide protein for the rapid growth demands of the infant. Some infants cannot tolerate egg white to start with so egg yolk must be used and the white introduced as the child approaches 1 year of age. Fish meal comes in very handy where meats are unaffordable.
6. Introduce legumes – alternative rich sources of protein. The seeds must be dehulled to improve digestion and prevent the problem of gas production which causes stomach upsets.
7. Introduce plantain and root crops. These tend to be bulky so when the child grows older nearing 10 to 12 months, he can handle them without over-tasking the capacity of the stomach.

Note:

- Each new food should be introduced in small quantities and gradually increased.
- The texture of food determines the child's attitude to the food being served to him. Therefore, it is important to consider the sequence of textures. Textures should begin with soft sloppy (porridge type) to mashed, minced or finely ground, to chopped.
- Over time, the child is introduced to a wide variety of foods and by 8 to 9 months, he should have attained a fairly good ability to eat family foods: mashed, chopped, or soft cooked foods, mildly seasoned.
- Increase quantity and frequency of complementary feeding while maintaining breast-feeding.
- Usually, a combination of meals and snacks should constitute complementary feeding.

LINKAGES (1999) suggested that complementary foods should be fed to 6 to 8 months old infants 2 – 3 times daily; 9 to 11 months old infants 3 – 4 times daily; and to 12 to 24 months old children 4 – 5 times per day. For good feeding practices during the first two years greatly reduce the risk that a girl will reach maturity stunted and at risk of obstetric complications and the delivery of a low birth weight infant.

Preschool Child (3 – 6 Yrs)

In comparison with the rapid growth rate during the 1st year, the child's growth rate slows down between 3 and 6 years but nutrient requirements are still high. Therefore, food continues to play a significant role in the child's growth and development.

Guide to Feeding the Pre-school Child

Emphasis here is on appropriate texture of meals, which are energy and nutrient dense to supply the child with high protein, enough energy, vitamins and minerals, and provided in quantities that the child can consume to maintain adequate growth. Careful food selection and preparation are essential to ensure that the child receives the right amounts of nutrients. Therefore, a variety of foods must be offered in a loving, caring atmosphere. Nutritious snacks play significant roles during the preschool years to help ensure sufficient food intake since the child's small stomach capacity cannot cope with large amounts of food at a sitting.

Inappropriate feeding practices during the first five years of life lead to malnutrition, often resulting in irreversible damage to physical and mental growth. Severe forms lead to the clinical syndromes of kwashiorkor and marasmus. Childhood malnutrition results in growth failure and

this represents the most prevalent expression of childhood malnutrition in developing countries (West 1991).

Worldwide, 200 million children of preschool age have stunted growth (Brown, 2000). FAO (1996) has also indicated that 199 million children below 5 years in developing countries suffer from chronic protein and energy deficiencies and data compiled by Administrative Committee on Coordination / Subcommittee on Nutrition (ACC/SCN) (1997) showed that 34% of them are stunted. Data on Ghanaian children under age five show that 26% are stunted, an indication that there is chronic malnutrition among young children (GSS and MI, 1999).

The physical, social and economic costs of early childhood malnutrition have far-reaching consequences and must be stopped. Kwashiorkor and marasmus are fatal if left untreated. Malnutrition increases morbidity and undermines the child's health. Torun and Chew (1994) explained that treatment of mild to moderate malnutrition corrects the acute signs, but children's catch-up growth may take a long time or might never be achieved. This results in stunting and a small body size, which may influence maximal adult working capacity and increase obstetric risk in females.

School-Age Child (6 – 11 Years)

The school-age period is marked by slow growth rate but body changes occur gradually. This is the stage during which body reserves are being laid down for the rapid adolescent growth ahead (Williams, 1993). Malnutrition will delay the growth spurt and hence affect sexual maturation.

Although no sexual distinction is made between the nutritional needs of boys and girls at this age, several studies show that boys have higher energy needs than girls and they tend to eat more.

Recommended Feeding and Dietary Needs

- Children must be fed a wide variety of foods including fruits and vegetables in sufficient quantities to meet their nutritional requirements.
 - Nutritious snacks preferably fruits should form part of the daily feeding plan to help meet their food needs.
 - Children must be fed 3 regular meals and 2 snacks.
- Obesity, a form of malnutrition must be checked at this age since it tends to persist into adulthood with its accompanying health problems.

Adolescence (12 – 19 Years)

This period of transition from childhood to adulthood is a relatively short period characterised by dramatic accelerated physical, biochemical, and emotional development. It is a period marked by a rapid enlargement of organs and tissues and sexual maturation (Guthrie 1989; Williams, 1993).

The recommended dietary allowances of this phase have some of the highest nutritive needs for males, and for females, is surpassed only by needs during pregnancy and lactation. Both males and females attain adult stature between 18 and 20 years although bone mass continues to increase until about 25 years. The minerals most likely to be inadequate are calcium, iron and zinc, all of which have a substantially increased need with rapid growth. Because zinc has its most profound influence on rapidly growing tissues, its effect on reproduction is significant. Zinc deficiency during adolescence retards growth and impairs or retards sexual maturation in both males and females. In males, sexual development coincides with the beginning of the growth spurt both of which are influenced by zinc. Zinc deficient males have shown retarded

development of the organ that produces sex cells. In animal studies, severely deficient animals are not able to reproduce (Guthrie, 1989).

Williams (1993) points out that in the adolescent female, the hip breadth increases and the bony pelvis widens in preparation for reproduction. Poor intakes of calcium and other nutrients needed for bone formation will result in a narrow pelvis which may pose an obstetric risk. Iron needs are of particular concern in teenage girls to make up for menstrual losses and prevent iron deficiency anaemia. If the nutritive intake of an adolescent girl has been inadequate before she conceives she is less able to cope with the added stress of pregnancy.

Recommended Feeding and Dietary Needs

- Need increased food intake comprising 3 regular meals and at least 2 nutritious snacks.
- Need for a variety of foods including daily consumption of fruits and vegetables to improve diet quality and micronutrient intake.
- Need vitamin/mineral supplements containing iron, vitamin A, zinc and others if micronutrient requirements cannot be met through available food sources.
- Need to use iodised salt, especially females.

Conclusion

I have so far attempted to demonstrate the effects of adequate nutrition and malnutrition on general and reproductive health throughout the different critical developmental stages in the life cycle. I have emphasised pregnancy and lactation because the nutritional status of women is a major determinant of both maternal and infant health and survival. Since pregnancy is considered a happy phenomenon in almost all societies, the need to ensure a successful course and outcome of pregnancy cannot therefore be an overemphasis.

Under favourable conditions, every child eventually becomes an adult and so for that child to reach adulthood and attain physical health including reproductive capacity, adequate nutrition during the growing years must not be overlooked. To sustain the process which maintains the wholeness of the body structure and function, good nutrition is needed to make the body ready for reproduction and when it takes place in the female.

Sound eating and dietary practices are needed by all throughout the life cycle. Therefore, to achieve adequate nutrition for all, nutrition education needs to be constantly intensified, certain cultural practices which restrict sound eating practices especially for women and children must be eliminated, micronutrient supplementation for pregnant and lactating women is a must, especially among the poor, and women's workload must be reduced.

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