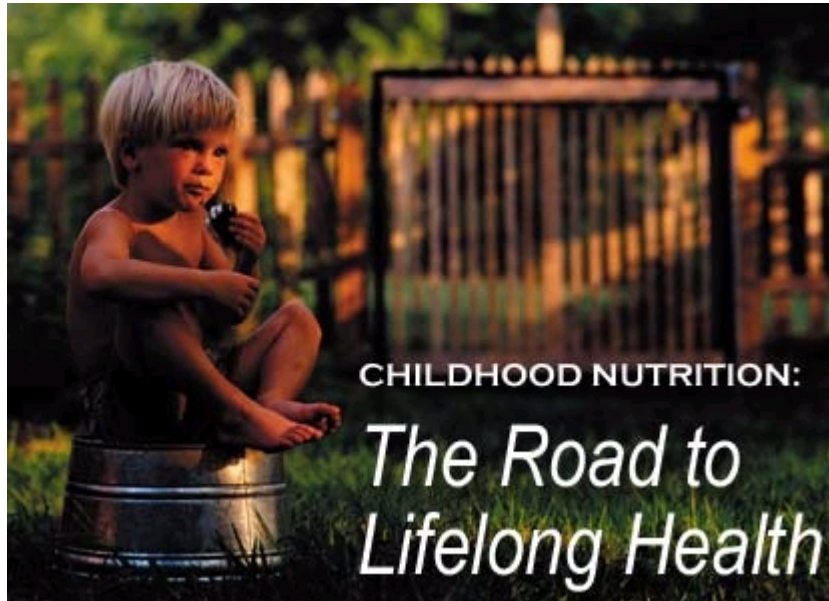


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REPORT



by: Angela Pirisi

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The role of nutrition can't be underestimated relative to a child's health, even before life begins outside the womb. So just how early on can nutrition impact on later health? Numerous studies have shown that proper maternal nutrient intake affects the health of infants, and can follow them right into adulthood by carving out a path toward disease prevention.

How early on can nutrition impact on later health? The most widely known example is the necessity of adequate folic acid intake prior to and into pregnancy in the prevention of neural tube defects.

Other research from the Birth Defects and Genetics Diseases Branch of the Centers for Disease Control and Prevention (CDC) has shown that multivitamin use in women from three months prior to pregnancy through the first semester was associated with a reduced risk of congenital heart defects in offspring.(1) The researchers suggest that if there is a causal relationship between inadequate nutrient intake and heart defects in infants, "approximately one in four major cardiac defects could be prevented by periconceptional multivitamin use."

While these studies obviously underline the importance of nutrition in pregnancy, their findings also speak to the fact that childhood diet lays the foundation for good health throughout our lives. The earlier that the pattern of good nutrition is established, the more likely that such healthy habits will stick over the years. A study that tracked 3714 elementary schoolchildren found that health behaviors instilled during elementary school years (a lower-fat diet and vigorous physical activity regimen) persisted into early adolescence.(2)

The nutrient shortage

Unfortunately, healthy eating isn't a reality for many US children. "Dole's Fruit and Vegetable Update: What America's Children Are Eating," a report released during a government hearing on the US dietary guidelines, presents dismal dietary habits. Of all food eaten at lunchtime, only 7.5% are vegetables and 8% are fruit. Only 16% of children's snacks include fruit and a mere 1% consist of vegetables, while over 50% consist of cookies, desserts, chips, salty snacks, candy and gum. At the dinner table, fruit makes up just 3% of food eaten, while vegetables add up to 25% of the meal. The US Dietary Guidelines recommends five to nine fruit and vegetable servings per day, as do many health education organizations with disease prevention at heart.



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As a result, kids are falling short of their nutritional requirements, as well as many of the benefits associated with various nutrients. According to findings from the 1994 -1996 Continuing Survey of Food Intakes of Individuals (CSFII), presented at an American Health Foundation symposium, 80% of children ages 2 to 11 fell critically short of getting 100% of the recommended daily amounts of calcium, iron and zinc, which are essential for growth and development. Moreover, half of the children were at risk of inadequate intake of these three essential nutrients (or getting less than 70% of the recommended levels). The researchers explain that, "Calcium is important for bone health and muscle movement; iron for support of brain development and the immune system and to help red blood cells carry oxygen, and zinc for cognitive performance and the immune system."

Meanwhile, data from several national surveys consistently show that children in the US have inadequate vitamin E serum levels, which is reflective of poor intake. Low vitamin E intake can impair immune response in children, and increase the risk of atherosclerosis and cardiovascular disease, cancer, cataract and impair immune response in adults.(3) Some breast-fed infants have been shown to be vitamin-D deficient due to the low content in mother's milk, which suggest the need for supplementation to ensure adequate calcium absorption and bone strength.(4) Other data from the third National Health and Nutrition Examination Survey found that the risk of inadequate zinc intake was greatest among young children ages one to three, adolescent females 12 to 19 years, and people 71 or older.(5) Earlier research has shown that zinc, taken as part of a multivitamin regimen, is crucial for children's growth.(6)

Children with certain conditions and/or who need to be on restricted diets seem to be particularly at risk of nutritional deficiencies. For example, a study in Cairo, Egypt showed that children with juvenile rheumatoid arthritis have demonstrated low plasma concentrations of various nutrients due to oxidative stress, including low albumin, ceruloplasmin, vitamin C and vitamin E.(7) A Brazilian study found low levels of plasma vitamin A and carotenoids in children with pneumonia, suggesting that the low concentrations "may be a consequence of acute phase infectious disease."(8) Meanwhile, children on milk-free diets, for allergy or intolerance reasons, suffer a loss of energy, fat, protein, calcium, riboflavin and niacin in their diet. Experts recommend that supplementation with calcium, vitamin D and riboflavin is necessary to replace cows' milk nutrients.(9) Likewise, children who have been on a vegan (macrobiotic) diet until age six reveal a low-cobalamin (vitamin B12) status as adolescents and related impaired cognitive function, even if they had switched to an omnivorous diet.(10) In summary, there are a variety of factors in children's health and lifestyle today that make even marginal deficiencies a reality to manage through improved nutrition and supplementation.

Fat chances of being healthy

Childhood obesity is the most visible consequence of a diet lacking in healthy choices. But its repercussions far exceed the teasing and psychological distress of being large in a thin-obsessed society, since obesity is also linked to many diseases, including asthma, diabetes, cancer, arthritis and heart disease. Science has also shown that the chances of a child growing into an obese adult correlates with the age at which a child starts to gain weight after shedding their baby fat. Usually, kids are thinnest at age five or six, but how early they reach a turnaround point in weight gain, called adiposity rebound, seems to predict how heavy they will be as adults. Basically, if children start putting on weight before their fifth birthday, they are more than twice as likely to be obese adults.(11) According to the American Academy of Pediatrics, 10% of four- and five-year-olds are too heavy for their age. National figures from the National Institute of Diabetes and Digestive Diseases (NIDDK) report that 11% of children, ages 6 to 17, are overweight. And not only are obese kids at risk for adulthood diseases, but they are also at higher risk of diabetes, hypertension, asthma, atherosclerosis and physical limitations during childhood. That's all the more reason for parents to leave picky eaters alone, since they will automatically start to eat more as they grow older. Instead, parents should ensure that kids get the right nutrients to see them through the finicky years, by offering them a diet with lots of variety to cover the bases, and perhaps a multivitamin for insurance.

Data collected by the Centers for Disease Control and Prevention (CDC) and the Tulane Center for Cardiovascular Health on 9167 kids showed that 11% of children 5 to 17 were overweight. Moreover, the heaviest among them were more than twice as likely to

have elevated cholesterol levels compared to thinner kids. Extremely overweight kids were at a greatly increased risk of high blood pressure and impaired insulin levels.(12) Similarly, an expert panel report from the American Diabetes Association (ADA) indicates that 8% to 45% (depending on age and racial/ethnic mix) of new cases of childhood diabetes are Type II (non-insulin-dependent), which is linked to obesity.(13) Figures rose from less than 4% of childhood diabetes being Type II in 1990 to 20%, and 85% of those children diagnosed were obese.

More food and calorie consumption doesn't translate into extra nourishment either but, rather, a depletion of vital nutrients. Vitamin stores are actually lower in both obese children and adults. For example, a Japanese study, which examined antioxidant status in obese children and the susceptibility of lipids to oxidative stress, demonstrated relatively lower levels of beta-carotene and alpha-tocopherol in them compared to normal-weight controls. Obese girls also showed significantly higher levels of oxidative stress in relation to both LDL beta-carotene and LDL alpha-tocopherol, which may promote atherosclerosis later in life, comment the authors. (14) Similarly, a National Cancer Institute study of adult males aged 30 to 59, found that higher body weight was inversely related to vitamin-C levels.(15) So while a weight issue may signify the need to consume fewer calories and increase physical activity, it also points to the necessity of increasing one's nutrient intake to offset the depleting effects that accompany obesity.



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Warding off cancer

More easily said than done, the ideal way to get all the essential nutrients would be to consume, as the American Cancer Society recommends, five to nine daily servings of fruits and vegetables, complemented by grains, low-fat foods and avoidance of animal source foods (i.e. meat). Since research is increasingly suggesting that predisposing factors to cancer development, whether environmental, dietary or otherwise, can set in early in life, it makes sense to heed this advice starting in childhood. Findings that were recently presented at the American Institute of Cancer Research Annual Conference 2000 suggest, for example, that one's childhood diet may predict breast cancer risk later on in life more strongly than diet during adulthood. While still unclear, the evidence suggests that higher consumption of estrogenic foods in childhood lower one's breast cancer risk, perhaps by altering something in hormone receptors.

As for fruits and vegetables, their merit seems to lie in the fact that they pack a number of vitamins and minerals that may ward off cancer development by reducing oxidative damage in various body tissues. For example, there's strong evidence to recommend vitamin C as part of a preventive nutritional stance against esophageal, oral, stomach and pancreatic cancer, as well as mounting evidence that it protects against cervical, rectal and breast cancer.(16) Other research suggests that a higher intake of vitamins A, C and E and carotenoids in combination offers a protective effect against lung cancer.(17) Likewise, folic acid supplementation has been linked to a 50% decreased risk of colon cancer, possibly because of folate's ability to repair damaged DNA.(18) Cancer prevention is only one reason to ensure proper nutrient intake.

Meanwhile, research that has been examining how nutrition may affect the development of brain tumors in young children—the leading cause of death from childhood cancer—has found a strong link to maternal diet. One study, for example, found that high vegetable intake (and their respective nutrients) and vitamin and mineral supplementation during pregnancy significantly lowered the risk of tumor development.(19) In particular, those expectant mothers who consumed the most vegetables, fruits and fruit juices, vitamin A, vitamin C, nitrate (from vegetables) and folate had the greatest amount of protection for their unborn child. As well, taking iron, calcium and vitamin C supplements anytime during pregnancy and early multivitamin use (during the first six weeks) also were related to a decreased risk. Other research from the National Cancer Institute shows that women who took vitamins A, C, E and folate throughout their pregnancy cut in half the risk of having a child who developed a brain tumor before the age of 5. In fact, the study showed that the risk reduction was proportional to how long the women took the supplements.(20)

Numerous other studies likewise revealed an inverse correlation between prenatal multivitamin use and reduced risk of pediatric brain tumors. The dietary substance to be most incriminated for posing a possible risk of brain tumor development in young children has been nitrosamines and their precursors, nitrites and nitrates, which are found in cured meats. If their role is indeed to promote cancer growth, that might equally explain the preventive function of nutrients such as vitamins C and E, which are known to inhibit nitrosamines. The significance of this protective effect of nutrients in utero against tumors during infancy and early childhood suggests that it may be worthwhile to look at how nutrition throughout childhood may prevent other forms of cancer that strike in adulthood.

Building better immunity

Adequate nutrient intake from a well-rounded diet and supplementation forms a front-line defense against infectious diseases by fortifying the body's immune response system. The most well-touted nutrients include the antioxidants, vitamins, A, C, E and beta carotene, as well as minerals such as iron, zinc, folic acid and calcium. Research has shown that deficiencies in micronutrients such as zinc and vitamins A and D reduce natural killer cell function, whereas supplemental zinc and vitamin C enhance their activity.(21) A 1992 groundbreaking Canadian study, which looked at the effects of a 12-month daily multivitamin regimen on infection-related illness, uncovered that subjects taking the supplement showed "higher numbers of T-cell subsets and natural killer



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cells, enhanced proliferation response to mitogen, increased interleukin-2 production, and higher antibody response and natural killer cell activity.”(22) The supplement users were also sick less often with colds and flu—23 days of the year compared to 48 days among the controls.

Vitamin A, in particular, helps build resistance to respiratory infections. In fact, studies from countries where vitamin A deficiency is common have shown that levels of the nutrient greatly affect the outcome of infectious diseases such as measles and pneumonia. A study involving 180 children (median age 30 months) with measles in rural Tanzania found a reduction in mortality among children who received vitamin A supplementation in addition to routine treatment.(23) A South African study of children with severe measles complicated by pneumonia found that vitamin A helped them to recover more quickly than controls from pneumonia (6.3 days versus 12.4 days), and diarrhea (5.6 days versus 8.5 days). Children treated with vitamin A had less croup (13 versus 27 cases) and spent fewer days hospitalized (10.6 days versus 14.8 days).(24)

Vitamin C, which is also known for immune-enhancing effects, has been shown to limit the symptoms of respiratory disorders such as asthma. In an Italian study of 18,737 children, ages six to seven, a higher intake of vitamin-C rich citrus and kiwi fruit diminished wheezing, shortness of breath, chronic and nocturnal cough, and non-coryzal rhinitis.(25)

Zinc is also known to be a key player in the immune system, as it aids in the development and function of neutrophils and natural killer cells. Zinc deficiency impedes the activity of macrophages, which compromise the roles played by cytokines and phagocytes.(26) According to a number of studies, zinc supplementation can increase resistance to infectious diseases such as pneumonia, diarrhea and malaria.(27)

Getting heart smart

Since heart disease takes years to develop, experts now suggest nutrition may be an integral part of early life intervention. After researchers examined the left heart coronary arteries from 760 autopsied men and women ages 15 to 34 (cause of death was an accident, homicide or suicide), they found that high blood cholesterol levels related to 2.5 times higher likelihood of advanced plaque blockages in their heart arteries compared to people with normal LDL levels.(28) Such findings, explained the investigators, provide “strong support to the idea that nutritional guidelines for the prevention of heart disease should be recommended for children as well as adults.”

For example, supplementation with folic acid, vitamins B6 and B12, can normalize homocysteine levels, found a University of Pennsylvania study. It suggested that “treatment with vitamin supplementation should be considered in all patients at risk for vascular disease.”(29) High blood levels of homocysteine are a predisposing factor for heart disease, and are present in about 20 million people in the US.(30) Folate intake has also been related to a drop in blood pressure readings. A study of urban minority adolescents at risk for hypertension found that mean diastolic blood pressure was significantly higher among youth with low-folate intake compared to those with a high intake.(31) The readings were about 8% higher among boys and 4% higher among girls with low-folate intake than in the controls. In addition, researchers found that the low-folate group also had significantly lower intakes of potassium, calcium, magnesium, beta carotene, cholecalciferol (vitamin D3), vitamin E and all B vitamins than the high-intake adolescents. The authors conclude that a diet rich in a combination of these lacking nutrients might contribute to primary prevention of hypertension when instituted at an early age.

Other heart-healthy nutrients are vitamins E and C, which studies have already shown to be beneficial for adults in reducing heart disease risk. For example, a large trial of 2002 patients showed that vitamin E could reduce non-fatal heart-attack risk by 77%.(32) A more recent study demonstrates that vitamin E might help to control, in children, the arterial damage that gradually leads to heart disease in adulthood.(33) California researchers gave subjects, ages 6 to 21, with an inherited tendency towards high blood lipid levels, 800 international units (IU) of natural vitamin E daily, plus 1000 milligrams of vitamin C daily, for six weeks. The combined regimen of vitamins E and C significantly increased blood vessel dilation, consequently improving endothelial function.

Meanwhile, L-carnitine, which has helped to treat cardiac failure patients, is now proving effective for treating cardiomyopathy in children.(34) Cardiomyopathy has many metabolic causes, and it can also result from carnitine deficiency. One study reported that serum-free carnitine levels in 24 children with heart failure were nearly 50% lower than those of 30 healthy controls.(35) Administering oral L-carnitine to the children with heart failure significantly improved their condition in less time than heart failure subjects who didn't receive oral L-carnitine.

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Improving thinking and behavior

Besides disease prevention, an adequate intake of proper nutrients can also have positive effects on mental health, behavior and cognitive function. The emergence of school breakfast programs to promote better academic performance through good nutrition bears witness to the fact that food fuels the brain. According to the American Dietetic Association, kids who eat breakfast learn better, are more alert and attentive in class, and more likely to participate in activities. A study that analyzed how an improved diet might help academic performance found that a daily vitamin-mineral supplement raised children's IQ and non-verbal intelligence, which is closely related to academic performance.(36)

In the experiment, 245 children, ages 6 to 12, were given a supplement that met 50% of the US daily recommended allowance (RDA) for three months, or a placebo. Results revealed a significant difference of 2.5 IQ points between the intervention and placebo group. The researchers concluded that, "The parents of schoolchildren whose academic performance is substandard would be well advised to seek a nutritionally oriented physician for assessment of their children's nutritional status as a possible etiology." Meanwhile, research that investigated the potential of multivitamin supplements to help mentally retarded children showed an increase of average IQ by 5% to 9.6% over a four-month period in supplement-treated children compared to negligible changes in controls; the supplemented group showed additional gains in IQ during a subsequent four-month period.(37)

The fact that food can also have an impact on hormones, serotonin levels and other neurochemicals suggests that it can affect emotions and behavior too, and that certain low nutrient reserves can adversely affect thinking and behavior. In attention deficit hyperactivity disorder (ADHD), for example, while genetic and environmental factors certainly play a role in the development of the disease, nutrient deficiencies are common too. For example, a study of 116 children showed that magnesium deficiency was evident in 95% of attention deficit hyperactivity disorder (ADHD) subjects, as measured in blood serum, red blood cells and hair samples.(38) Oral supplementation with 200 milligrams of magnesium per day for six-months, on the other hand, has shown a significant decrease in hyperactivity among children with a diagnosis of attention deficit hyperactivity disorder (ADHD).(39) Likewise, research has demonstrated the success of a combined regimen of magnesium and vitamin B6 to improve behavior in autistic children, by eliciting both biochemical and electrophysiological changes.(40)



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Zinc, which is vital for metabolism among neurotransmitters, fatty acids, prostaglandins, melatonin and dopamine, has also been shown to possibly help attention deficit hyperactivity disorder.(41) In addition, some other research has suggested that supplementation with B vitamins, essential fatty acids, flavonoids and the essential phospholipid phosphatidylserine (PS) can improve hyperactivity symptoms when made part of an integrative therapeutic approach.(42) Essential fatty acids, in particular, seem to play a vital role in behavior. Research has shown that an omega-3 acid deficiency in some boys, ages 6 to 12, correlates to a higher frequency of behavior, learning and health problems consistent with attention deficit hyperactivity disorder (ADHD).(43) Omega-3 fatty acids are essential to the proper functioning of the nervous system, which may explain their effect on behavior.

The role and mechanism of many individual nutrients in the prevention and treatment of various health conditions that plague us today remain to be elucidated. What is apparent already from the mounting scientific evidence to date, though, is that there's an obvious need for adequate nutrient intake, and for assessing the areas where a typical North American diet may fall short in safeguarding our children's current and future health. Applying what we know so far, we can provide some guidance and foster the right dietary and lifestyle habits early on in life to offer people protection from a number of diseases from childhood right through to old age.

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