NUTRITION AND PHYSICAL PERFORMANCE IN SCHOOL AGE CHILDREN

WRONG HABITS

RIGHT HABITS

Eat a lot of these regularly

Eat these once in a month/once in a fortnight

Consume very little fish, meat or milk

Take one or more of these items everyday

Low pulse consumption

Pulse should be consumed daily

Eat lots of refined cereals and flours

Eat in moderation. Consume more coarse grains and less refined flour

Eat very little fruits and vegetables

Eat as many fruits and vegetables as possible

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NUTRITIONAL STATUS OF CHILDREN IN INDIA

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Nutritional status of preschool children reflects the overall development of the community. Undernutrition is a cumulative effect of factors such as poverty, inadequate intake of food, illiteracy & ignorance, food taboos, large family size, poor personal hygiene and environmental sanitation, lack of basic health care facilities and inadequate access to safe drinking water (WHO 2003). The recent WHO new child growth standards study (2006) in different countries has clearly established the fact that, given optimal conditions, growth of the children will be similar irrespective of the country they belong to. In spite of rapid growth in agriculture and industrial achievement in the recent past, undernutrition continues to be a major public health problem in India. One of the major causes of under five-year mortality is undernutrition in almost all the developing countries. Several studies have also shown that intra-uterine growth retardation, low birth weight and undernutrition during childhood may also lead to higher risk of developing obesity during adult life. According to the recent surveys (2005-06) carried out by the National Nutrition Monitoring Bureau (NNMB), only about one third of preschool children were consuming adequate amounts of protein and energy and a fifth of them were consuming diets deficient in both the nutrients. According to WHO child growth standards, the prevalence of underweight (<Median–2SD) was 40%, stunting 45% and 16% were wasted among <5 year children. However, none of them exhibited signs of kwashiorkor or marasmus. In spite of launching of several nutrition intervention programmes, micronutrient deficiencies are still largely prevalent. The median intake of various micronutrients such as iron, vitamin A, folic acid and riboflavin are grossly inadequate. More than 70% of children were consuming <50% of RDA of these nutrients. About 70% of preschool children suffer from anaemia and 60% from sub-clinical vitamin A deficiency. According to the WHO-NIN obesity study on urban adolescents carried out during 2007 in Andhra Pradesh, the prevalence of overweight (≥85th centile) was 6% (CI: 5.2, 6.2), and it was significantly higher ($p<0.05$) among girls (7.1%; CI: 6.3, 7.9) compared to boys (4.4%; CI: 3.8, 5.0). Multivariate logistic regression analysis has revealed that the risk of overweight was 3 times higher among the adolescents, who have not participated in out door games and sports and 2 times among adolescents who did not participate in household activities and 2 times higher among adolescents, who were watching TV ≥3hrs/day. There is an urgent need to strengthen the implementation of all the existing nutrition intervention programmes and improve infant and young child feeding practices among

lactating women through IEC. Scope of micronutrient fortification of food supplements under ICDS programme should be explored. Fortification of staple foods such as wheat flour, rice and other foods like milk, bread etc also should be considered. There is also a need to strengthen indirect intervention programmes such as environmental sanitation, supply of safe drinking water, household nutrition security, income generating activities, and initiation of timely interventions in emergencies such as droughts, earthquakes, floods, etc which will go a long way in improving the situation.

NUTRITION AND PHYSICAL PERFORMANCE IN SCHOOL AGE CHILDREN

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Obesity, a natural consequence of over-nutrition and sedentary lifestyle, is increasing rapidly in children and adolescents of developing countries including India. This is leading to an increased risk of morbidity and mortality due to various metabolic problems such as diabetes, and cardio vascular diseases. A recent survey conducted by us on 20,537 school adolescents aged 14 – 18 years indicated a prevalence of overweight/obesity as 25.3 and 8.6 percent in private and public schools, respectively across 6 cities in India. In Delhi city alone, the prevalence was 34.5% in private schools. The prevalence of obesity is largely due to rapid urbanisation and nutritional transition leading to increase in energy intake along with a reduction in its expenditure. Moreover, easy availability of energy dense foods is greatly contributing to the effect. Nutrient intake demonstrates an imbalanced dietary intake profile of Asian Indian adolescents. While the total energy (kcal/day), carbohydrate (g/day) and protein (g/day) intakes are within or less than the recommended for Asian Indians, the intake of dietary fat (g/day) and saturated fat is remarkably high predisposing the them to increased risk of non-communicable diseases like type 2 diabetes mellitus, insulin resistance, hypertension, dyslipidemia and coronary artery diseases. Surveys conducted amongst school adolescents residing in Delhi city reveal that 1 in every 3 eats out once or more in a week. Intake of calorie dense foods reveal that half of the children eat chips once or more in a week, while 22.7 and 36.4 percent of them have an intake of burgers and pizzas once or more in a week, respectively. Similar is the intake for colas with more than 35% children having an intake once or more in a week. Quantifying the cola intake reveals an extra intake of 237 kcal per week. Physical activity among the urban children shows not more than 68% children spend time in outdoor activities indicating lack of physical activity. Surveys conducted in India amongst children and their parents indicate that here are major gaps in their health and nutrition-related knowledge and behaviour. With educative intervention being given to children through the school based approach, a favourable impact has been observed on the knowledge and behaviour with regards to health, nutrition and diseases. Comparison of Indian and American diets revealed little difference. Dietary intake in our study group revealed a high total fat and saturated fat intake with a low intake of MUFAs and ω-3 PUFAs, predisposing them to an increased prevalence of obesity and insulin resistance. Obesity has been shown to be a powerful correlate of cardiovascular risk in comparison to

hyperinsulinemia. And insulin resistance was strongly associated with obesity. Hence indicating that early identification of these risk factors in adolescents can prevent the increasing risk of cardio-vascular diseases and diabetes (type 2). With a high imbalance of nutrient intake and lack of physical activity, resulting in a high incidence of obesity across the country, there is an immediate need to initiate basic health and nutrition awareness programs across India regarding reduction in the intake of energy dense foods, especially fatty foods. It is also essential to disseminate messages about a healthy lifestyle through educative community interventions in the country. Project MARG: The Path is a similar initiative by Diabetes Foundation (India) in north, central and west India. Innovative and locally appropriate strategies are being used for spreading awareness for the prevention of obesity and diabetes. Health check-ups in the form of nutritional assessment through anthropometric measurements of height and weight, individualized counselling and special programs are being organized for the high-risk group children and their parents. Social participatory events such as poster making, skit/drama, cookery/healthy snack making, debate/extempore, slogan writing, essay/paragraph writing, quiz competition, health mela/festival, etc. are being organized to spread the awareness for the prevention of obesity and diabetes. To make the program sustainable, volunteers are being trained as peer educators and aid in spreading the healthy messages. Initiatives are being undertaken to modify the home and school environments for he cause. Options of healthy foods and subsidized costs are being made available to the children in the school canteens. Reports on educative interventions directed towards children and their parents are showing encouraging results, but large-scale countrywide initiatives need to be initiated.

ASSESSING PHYSICAL FITNESS IN CHILDREN – METHODS AND CONSIDERATIONS

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Physical fitness can be considered as an integrated measure of several body functions involved in the performance of daily physical activity and/or physical exercise. Cardio-respiratory fitness, also called cardiovascular fitness or maximal aerobic power, is the overall capacity of the cardiovascular and respiratory systems and the ability to carry out prolonged strenuous exercise. The maximal oxygen consumption (VO2max) attained during a graded maximal exercise to voluntary exhaustion has been considered by the World Health Organization as the single best indicator of cardio-respiratory fitness. The VO2max can be estimated using maximal or sub-maximal tests, by direct or indirect methods. The most commonly used tests are walking/running tests followed by cycling and step tests. In epidemiological studies involving young people, the most common test for assessing cardio-respiratory fitness has been the 20-m shuttle run test, or adaptations/modifications of this test.

Muscular fitness is the capacity to carry out work against a resistance. The main health-related muscular fitness components are maximal strength (isometric and dynamic), explosive strength, endurance strength and isokinetic strength. The handgrip test is one of the most used tests for assessing muscular fitness in epidemiological studies. Speed is the ability to move the body (or some parts of the body) as fast as possible. Agility is the ability to move quickly and change direction while maintaining control and balance. Consequently, agility is a combination of speed, balance, power and coordination. The 30-m sprint test and the 4x10-m shuttle run test are useful tests for assessing speed and/or agility, respectively, in young people.

Whether physical fitness is an important marker of health already in childhood and adolescence is still under debate since most of the evidence comes from cross-sectional studies. In the last decades, several longitudinal studies in children and adolescents reported on the relationship between physical fitness-related exposures and the risk of developing an unhealthy cardiovascular or musculoskeletal profile later in life. Understanding whether low/high physical fitness in young people is a predictor of future disease/better health status would clarify the debate if physical fitness should or not be assessed in health monitoring systems. There is strong evidence indicating that high levels of cardio-respiratory fitness during childhood and adolescence are associated with healthier cardiovascular profiles later in life. Muscular strength improvements from childhood to adolescence are negatively associated with changes in overall adiposity.

Despite further methodological research is still needed for a better understanding of the accuracy, validity and reliability of the available fitness tests, physical fitness should be considered as a useful health marker already in childhood and adolescence, reinforcing the need to include physical fitness testing in health monitoring systems. Physical fitness enhancement, through increases in the time spent in moderate-vigorous physical activity should be a major goal in current and future public health promotion policies.

NUTRITIONAL INTERVENTION FOR OPTIMISING PHYSICAL FITNESS IN CHILDREN

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There are relatively few studies that have focused on the relationship between nutrition and physical fitness in children. A major part of the literature is in relation to nutrition and performance of elite athletes. Evidence for the role of nutrients, particularly micronutrients and physical performance comes from observational studies and experimental studies involving micronutrient supplementation or restriction. A bulk of these studies have been done on adults. Studies that focus on children have added problems as there are several unique confounders; linear growth and weight gain, structural and functional changes associated with puberty, subject compliance and the inter-individual variability associated with the physical performance measures. The physical performance measures, themselves, are less well studied in children in general as compared to corresponding measures in adults. These factors play an important role in study design of nutrition interventions on physical performance in children.

Details will be provided of a recently concluded randomized, double blind, placebo controlled study that was designed to assess the impact of a multiple micronutrient fortified nutritional powder (containing 19 key vitamins and minerals) on physical performance measures. Clinically healthy school-going children (n=300), between 7 and 11 years (equal numbers of boys and girls), with height and weight-for-age z scores between 0 to -3 were randomized to three study arms; fortified nutritional powder (TEST), an energy equivalent unfortified nutritional powder (CNTRL) and no intervention (NOTRT). Children who had been part of any nutrition intervention study the previous year were excluded. The primarily supervised interventions were given daily for 4 months. Primary efficacy outcomes included endurance and aerobic capacity from the 20m shuttle test and step test. Speed (40m sprint) and visual reaction time, were also measured. Biochemical assessment included iron status and vitamins B2, B6, B12, C and red cell folate at baseline and the end of intervention. Dietary intake and physical activity patterns were measured before, during and after the intervention. The three groups were largely comparable in their socio-economic status, anthropometry, dietary and physical activity patterns, biochemical status and physical performance at baseline. There was a significant increase in whole body endurance and aerobic capacity in the TEST group as compared to the other groups accompanied by a significant improvement in iron status and vitamins B2, B6, B12, C and folate contained in the fortified nutritional powder.

The study suggests that multiple micronutrient supplementation in similar populations may be beneficial in improving micronutrient status and in enhancing endurance and aerobic capacity. The mechanisms by which multiple micronutrients work to optimize or enhance physical performance/ fitness should be studied further

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ROLE OF PROTEIN IN PHYSICAL PERFORMANCE

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The role of dietary protein on physical performance appears to be in tandem with the effect of exercise. While physical performance is dependent on a number of factors that include the type of exercise, genetic determinants, training, motivation and micronutrient status, it would appear that the muscle mass is critical for physical performance. The development of the muscle mass is profoundly dependent in itself, on exercise, thereby defining a virtuous cycle of exercise benefiting muscle, which in turn benefits physical performance.

Normally, the body muscle mass remains constant because periods of positive balance following feeding are countered by periods of negative balance during fasting. Muscle growth can only occur if muscle protein synthesis exceeds muscle protein breakdown, such that there is a net positive muscle protein balance. A combination of resistance exercise and nutrition has anabolic effects through the stimulation of muscle protein synthesis from dietary protein/ amino acids and through the attenuation of muscle protein breakdown by carbohydrates. However, the magnitude of the muscle protein accretion response may also be influenced by the timing of ingestion, co-ingestion of nutrients and the type of protein ingested.

While resistance exercise improves muscle protein balance, the diet (both protein and energy) plays an important part in this process. The acute response of muscle protein metabolism to a bout of exercise depends on the interaction between protein metabolism and consumption in the post-exercise period. The type of protein is relevant, as milk protein has been shown to result in a better accretion response than hydrolyzed soy proteins. Hormones, especially insulin and testosterone regulate muscle protein synthesis and muscle hypertrophy. However, most data in this area are from acute experiments, and while the ingestion of amino acids and energy can transiently increase muscle protein anabolism, it is not yet clear whether this transient response translates into an appreciable muscle hypertrophy over time.

There are two further broad issues that need to be addressed: the first relates to progressive aging and the loss of muscle mass and its impact on health, and the second to a balanced approach to diet and muscle mass. With regard to aging, there is a progressive loss of skeletal muscle mass and strength, leading to the loss of functional capacity and an increased risk of developing chronic

metabolic disease. While recent studies suggest that the muscle protein synthetic response to food intake is blunted in the elderly, it is clear that physical activity or exercise stimulate protein accretion in both the young and elderly. However, this stimulation, and the net protein balance could depend on the protein intake prior to, during, or after exercise. The lack of adequate protein intake and exercise may result in a vicious cycle of inactivity, less muscle mass and less functional capability. More research is required to accurately delineate the interaction between protein intake, exercise and the skeletal muscle adaptive response.

In terms of a balanced approach to dietary intervention, it is important to realize that an unbalanced approach to muscle mass enhancement and physical performance, through unnecessary or excessive intake of protein, will not be effective or safe. Interventional approaches that include attention to protein intake will need to consider a balanced diet (energy and micronutrients) as well as a balanced lifestyle.

ROLE OF MICRONUTRIENTS IN PHYSICAL PERFORMANCE

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Whereas the adverse effects of restricted intakes of protein, fat, and carbohydrate on physical performance are well known, there is limited information about the impact of low intakes of vitamins and minerals on the physical performance and exercise capacity. Many vitamins and minerals play key roles in energy metabolism. Many vitamins, particularly the water-soluble vitamins, are involved in mitochondrial energy metabolism: it is, therefore, intuitively attractive to believe that supplying additional amounts may be beneficial.

There has been a steady accumulation of evidence that iron deficiency anemia limits maximal physical performance, submaximal endurance, and spontaneous activity in the adult, resulting in diminished work productivity with attendant economic losses. Iron deficiency, with or without anemia, impairs muscle function and limits work capacity. The relative importance of central and peripheral mechanisms underlying these effects, the extent to which anemia or iron deficiency separate from anemia is responsible, and the counterpart in infants and children remain to be established.

Magnesium, zinc and chromium deprivation increases oxygen requirements to complete submaximal exercise and reduces endurance performance. Magnesium plays a number of vital roles in the regulation of energy metabolism, acting as a cofactor and activator for a number of enzymes, and is also involved in calcium metabolism and in the maintenance of electrical gradients across nerve and muscle cell membranes. Zinc is also involved as a cofactor in many enzyme reactions, and has many other roles, including promotion of tissue repair processes. Copper is another divalent cation with important biological functions including modulation of enzyme activity and also a role in the synthesis of haemoglobin, catecholamines and of some peptide hormones.

Vitamin D deficiency can cause a myopathy of varying severity. Clinical studies have indicated that vitamin D status is positively associated with muscle strength and physical performance and inversely associated with risk of falling. Vitamin D supplementation has shown to improve tests of muscle function, reduce falls, and possibly impact on muscle fiber composition and morphology. Acute ingestion of phosphorus (phosphate loading) has been shown to improve aerobic capacity.

Severe deprivation of folate and vitamin B12 result in anemia and reduce endurance work performance. Some studies have reported that supplementation with vitamins C and E, selenium and other antioxidants, or antioxidant mixtures can reduce symptoms or indicators of oxidative stress as a result of exercise.

However, there is still no substantial evidence to suggest that specific supplementation with any of these dietary components is necessary or that it will improve performance. Use of vitamin and mineral supplements does not improve measures of performance in people consuming adequate diets. Vitamin and mineral supplements are not needed if adequate energy to maintain body weight is consumed from a variety of foods. However, individuals who suffer from deficiency states, who restrict energy intake, use severe weight-loss practices, eliminate one or more food groups from their diet, or consume unbalanced diets with low micronutrient density may require micronutrient supplementation.

PHYSICAL FITNESS AND PERFORMANCE IN SCHOOL AGED CHILDREN

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The prevalence of overweight among children and adolescents in the United States have been shown to increase dramatically in the last forty years (1964 to 2004) from 4 to 17% among both children and adolescents (National Center for Health Statistics Report: 1999-2002). A Child Development Centre study on 3339 adolescent school going girls between 13 – 15 years of age in Thiruvananthapuram district have shown an overweight prevalence of 7.5% (using >95th centile-NCHS), 8.7% (IOTF values) and 9.2% as per Indian standards (KN Agarwal). This may also be linked to the increasing prevalence of Poly Cystic Ovary Syndrome among adolescent girls, 80% of them having associated obesity. Even 5 to 10% reduction in body weight helps to regulate the menstrual cycle. Apart from the possibility of infertility later on, those with the syndrome are at risk for diabetes, coronary artery diseases and dyslipidemia.

Obese children are more likely to become obese adults than their lean peers. Up to 70-80% of those obese children between 10 – 13 years are likely to be obese adults later on (Relative Risk 6.0 : NCHS, CDC). Obese children are more likely to be obese adults, especially if their parents are obese; 40% children with 1 obese parent and 70% with 2 obese parents become obese. Most adult life style diseases have their onset in childhood and adolescence. Will Today's Child be Tomorrow's Cardiac Patient? Possibly Yes!, if they develop obesity, hypertension, dyslipidemia, insulin resistance and smoking habit in adolescence. The studies say that major cardio-vascular disease (CVD) risk factors start operating from childhood, dyslipidemia and atherosclerotic changes start in young adults and adolescents and that BMI, BP, low HDL cholesterol at 15 years correlated with coronary artery disease in adulthood.

Physical fitness

The physical fitness at any age encompasses nine dimensions namely; (i) strength, (ii) power, (iii) agility, (iv) balance, (v) flexibility, (vi) local muscle endurance, (vii) strength endurance, (viii) co-ordination and (ix) cardiovascular endurance. Of the 9 elements of fitness cardiac-respiratory qualities are the most important to develop as they enhance all other components of the conditioning equation.

Cardiac coefficient: These coefficients are calculated from mean cardiotachogram and frequency spectrum. The values of this coefficient below six (in relative units) are unfavorable and can be a result not only from inadequate heart training, but also from any kind of processes, which decrease the intensity of the myocardium constrictions.

Vascular coefficient: The values of this coefficient below six (in relative units) are unfavorable and can be a result of decreased sensitivity of the baroreceptors. The cause for this includes an increased blood pressure or a beginning stage of atherosclerosis development.

Training (fitness) index: This is the global (general) assessment of the persons' capability to respond to the orthostatic stress requirements. Fitness index values below six (in relative units) are unfavorable and can be a result of immobilization, overweight, convalescence, and all other types of diseases affecting the physical condition of the individual. Usually, non-trained individuals exhibit slowdown of the heart accommodation (increased pulse while standing up) and recovery (decreased pulse while sitting down).

Fitness testing

The advantage of 'fitness test' is an easier, faster and safer execution, which makes it suitable for mass preventive examinations. 'Aerobic fitness' can be defined as the ability to continue to do fairly hard physical work over a prolonged period (eg, for 30 minutes or more). A good predictor of a person's aerobic fitness is their 'maximal oxygen uptake' (VO2max). It is the best all-round predictor of a person's ability to perform sustained physical work and best measured using a treadmill exercise and measuring oxygen consumption. Typical VO2max results for sedentary young men are around 40 mL/kg/min. Regular exercise (jogging for 20-30 mts 3-5 times/week) can improve VO2max by 10-20%.

Nutrition and Athletic Performance

For athletes nutrition and supplement use is a common way to augment a steady training program. Arguments have gone on for years about the best diet for optimal athletic performance. Those arguments will probably continue for years as well. It is the position of Dietitians of Canada, the American Dietetic Association, and the American College of Sports Medicine that physical activity, athletic performance, and recovery from exercise are enhanced by optimal nutrition. These organizations recommend appropriate selection of food and fluids, timing

of intake, and supplement choices for optimal health and exercise performance. During times of high physical activity, energy and macronutrient needs - especially carbohydrate and protein intake - must be met in order to maintain body weight, replenish glycogen stores, and provide adequate protein for building and repairing tissue. Fat intake should be adequate to provide essential fatty acids and fat-soluble vitamins, as well as to help provide adequate energy for weight maintenance. Overall, diets should provide moderate amounts of energy from fat (20-25% of energy), there appears to be no health or performance benefit to consuming a diet containing less than 15% of energy from fat. Body weight and composition can affect exercise performance, but should not be used as the sole criterion for sports performance. Consuming adequate food and fluid before, during, and after exercise can help maintain blood glucose levels during exercise, maximize exercise performance, and improve recovery time. Athletes should be well hydrated before beginning exercise; they should also drink enough fluid during and after exercise to balance fluid losses. Consumption of sport drinks containing carbohydrates and electrolytes during exercise will provide fuel for the muscles, help maintain blood glucose levels and the thirst mechanism, and decrease the risk of dehydration or hyponatremia. Athletes will not need vitamin-and-mineral supplements if adequate energy to maintain body weight is consumed from a variety of foods. However supplements may be required by athletes who; restrict energy intake, have severe weight-loss practices, eliminate one or more food groups from their diet, or consume high-carbohydrate diets with low micronutrient density. Nutritional ergogenic aids should be used with caution, and only after careful evaluation of the product for safety, for efficacy, for potency, and to determine whether or not it is a banned or illegal substance. Nutrition advice, by a qualified nutrition expert, should be provided only after the athlete's health, diet, supplement and drug use, and energy requirements have been carefully reviewed.