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CONTENTS

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Malnutrition in Asia and Neurological Consequences

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ABSTRACT

Prevalence of malnutrition is a global phenomenon but the greatest contribution towards it is from the developing countries. Malnutrition impairs physical growth, cognitive functions of brain, physiological functions, immune response changes. Twenty Seven percent of children under 5 years are malnourished in the developing countries. India contributes to approximately 5.6 million child deaths annually with almost one billion children dying worldwide from the consequences of malnutrition. Malnutrition produces lasting effect on developing brain during the "Brain growth spurt" phase which corresponds to the period from 30 weeks of gestation to two-year of post natal age. In the peripheral nervous system the growth of axons, migration of Schwann cells and onset of myelination starts at 14 to 20 weeks of gestation.

Malnutrition causes muscle wasting, hypotonia and impaired deep tendon reflexes from 30-40% of malnourished children. Deficiency of micronutrients in malnourished can cause myelopathy, peripheral neuropathy, dementia, infantile seizures, infantile tremor syndrome, night blindness, optic neuropathy and spinocerebellar degeneration.

Keywords : Malnutrition, prevalence, central nervous system, peripheral nervous system.

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Introduction

According to United Nations statistics about 25% of Indian population particularly children <14 years are undernourished. Nervous System disease due to dietary deprivation appears under circumstances as diverse as famine, extreme poverty, intestinal malabsorption due to disorders such as sprue, chronic infections and administration of metabolic antagonists such as INH, anorexia nervosa and food fads, especially among adolescents. Protein Calorie Malnutrition or Protein Energy Malnutrition (PEM) in children produced by failure of lactation/ inadequate food intake is due to poverty.

Epidemiology

Malnutrition is a predominant problem of the tropics due to poverty, over population, illiteracy and socioeconomic disparity. According to UNICEF, Asia pacific is home to 50% of slum population worldwide, with 30% children <5 yrs being underweight. Fifty percent of world's malnourished resides collectively in India, Bangladesh and Pakistan. To anextent of 54% deaths in children in developing countries are due to PEM. 300, 000 children <5 yrs die per year in developing countries (WHO).

According to WHO by 2015 malnutrition will decrease by 17.6%. Globally 113.4 million children younger then 5 yrs are affected. Malnutrition decreases educational achievement, labour productivity and economic growth. Under nutrition during pregnancy linked with low birth weight and low brain weight.

National survey 2004-05 in India (1) showed that out of 1.1 billion population 38% are poor and 40% new born are under weight. Northern region which is bread-bowl of India almost 80% infants are anaemic, every 2nd child is stunted, every 3rd child of educated mother is malnourished and 60% children anaemic (2).

In India, according to Economic Survey 2008-2009, 5.6 million children die annually due to malnutrition (3). Forty percent of worlds' malnourished children are from India. State wise, Madhya Pradesh has highest malnourished children, i.e. 60.3% and with Jharkhand being 2nd with 59.2%. The prevalence of severe PEM in India is 5 million. Countrywise data are illustrated on the startup of underweight children (Fig.1), acute malnutrition (Fig. 2) and malnutrition underweight and stunting inchildren (Fig. 3).

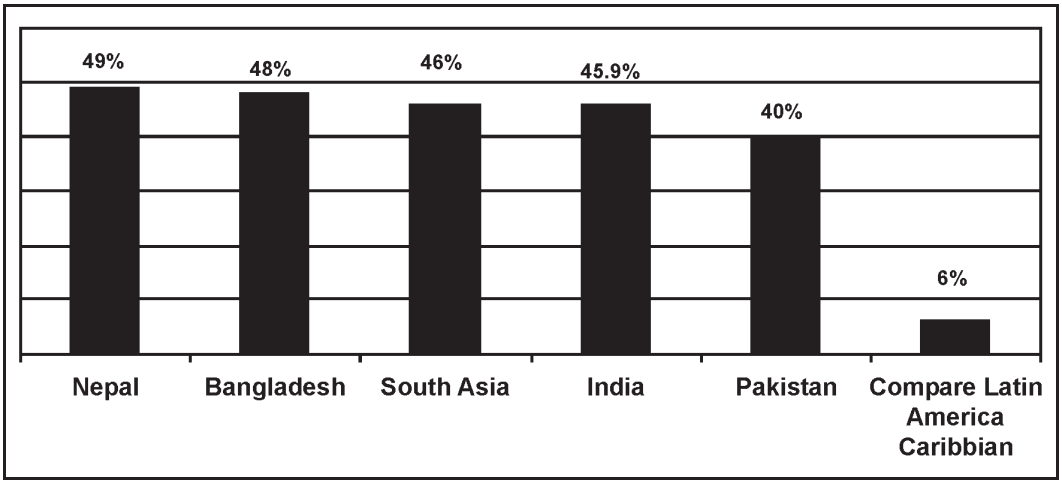

Fig. 1 : Under Weight Children

Millions are malnourished in Bangladesh(48%), 11.7% are wasted, 57.5% are stunted, 60.0% are low weight and height, 70% women are anaemic, 20% goiter and 9% have rickets in this country (4).

In Pakistan 40% children under 5 years are malnourished, 35.2% are undernourished and 32.6% population is below poverty line.

Nepal one of the poorest country of the world has highest (49%) malnutrition in south Asia, its 50%population is stunted, 40% anaemic and 40% with

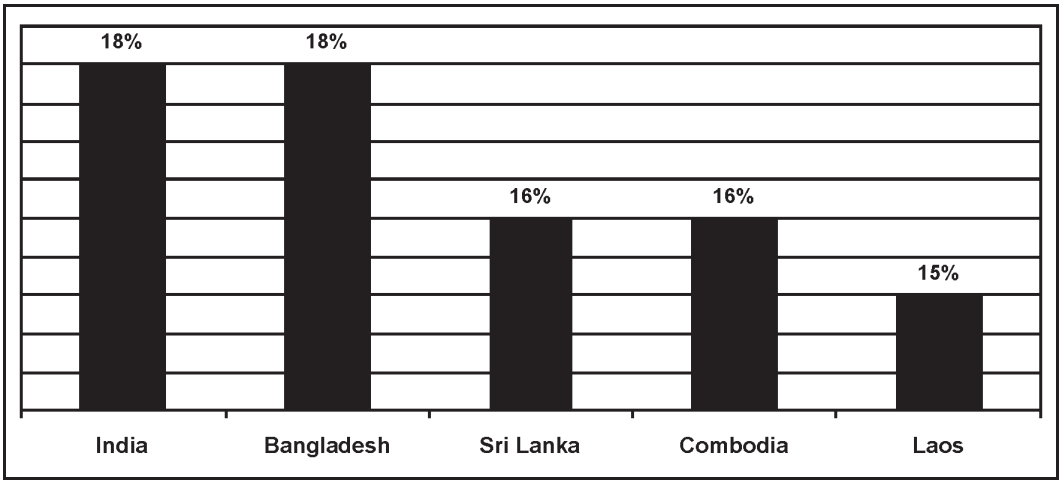

Fig. 2 : Acute Malnutrition

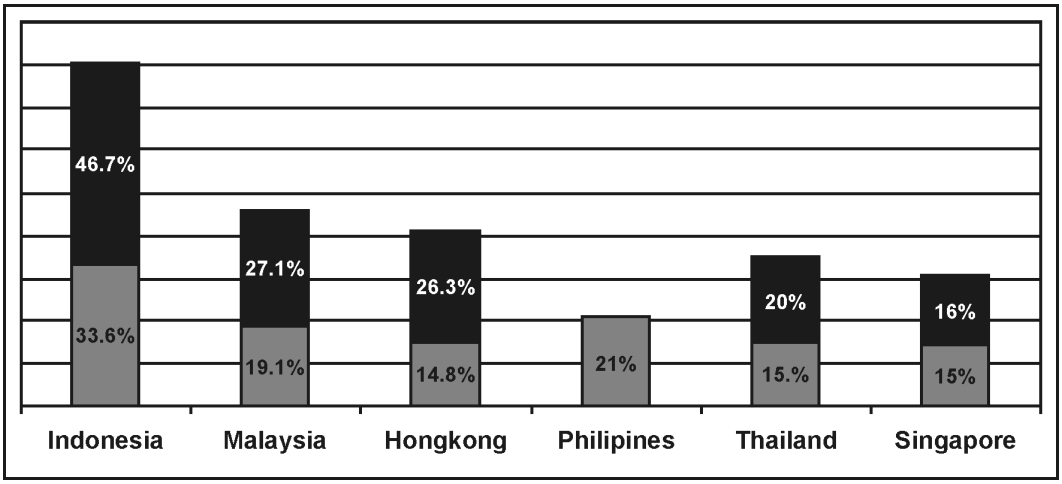

Fig. 3 : Malnutrition, Under-weight, Stunting (UNICEF, UN)

iodine deficiency. Twenty eight percent of its population survive on one US dollar a day. In Myanmar 33% young children suffer from chronic malnutrition and 82% eat damaged rice. In Sri Lanka 22% children are underweight, 18% are stunted and 15% suffer from acute malnutrition. In Jaffna area 24% suffer from acute malnutrition (5).

In Afghanistan a child dies every 3 seconds, 50% live below poverty line, 54% under 5 years are stunted and 72% under 5 years are anaemic. In Cambodia 40% population live below poverty line, 90% are poor in rural areas, 33% population is malnourished and it is highest in South Asia, 45% under 5 years are stunted.

Laos, North Korea, Vietnam and Mangolia, there is also very high level of malnutrition, 50% children below 5 years, 60% children (6 months to 7 years), 35-45% under 5 years and 13% are malnourished, respectively.

Effects on Developing Nervous System

Human brain growth spurt begins at 13th week gestation and continue till 4th year after birth (6). The neuronal multiplication ends at birth and glial multiplication ends little later. Myelination starts during second half of growth spurt period (7). Cellular proliferation, migration, myelination and synaptogenesis occur in early phase of development. White matter is more vulnerable to PEM than grey matter. If nutritional deficiency occurs during growth spurt, it can cause irreversible

damage to CNS, muscle and peripheral nerves are less affected. Complete recovery occurs if adequate nutrition is started early and recovery is partial if nutritional correction is delayed (8).

Lamination of cord tracts identifiable by 14th week and adult pattern is reached by 30th week. In peripheral nervous system myelination starts by 14-20th week of gestation and continues till 4th postnatal year. Protein calorie malnutrition results in lack lustre scholastic performance, inadequate perception, maladjustment at home and school (9). Further the children show attention deficit, easy distractibility, low IQ, impaired memory and cognition. Abstract abilities are worst hit. Beneficial effects are noted following protein supplementation (9). Malnutrition also impairs physical growth, cognitive and physiological function and impairs immune response.

PEM and Nervous System

Functional deficit were noted in nerve and muscle due to reduced protein synthesis, reduced oxygen uptake, functional impairment of mitochondria, instability of ribosomes and enhanced IGF 1 and 2 binding.

EEG showed nonspecific slowing with delayed peripheral and central conduction on SEP. BAER is prolonged in 40% Kwashiorkar children (10).

Nutritional deficiency

Classification based on deficient nutrients

1. Protein and/or calories

   Primary PEM: - Marasmus
   - Kwashiokar

   Secondary PEM:- Marasmus-kwashiorkor

2. Specific Deficiency

   Primary : Vitamin B1, B2, B3, B6, B12, Folate, C

   Vitamin A, D, E, K, and mixed

   Conditional: (dependency states)

   Minerals: Calcium, Iron, Magnesium, Zinc, Iodine, Copper, Selenium, etc.

Protein deficiency

***Kwashiorkor* :** This type of malnutrition is usually seen in the age group of 2-3 years with edema, hair changes, stunted growth and hypoalbuminemia.

Marasmus is seen usually between 6-18 months with growth retardation, decrease protein calories which can be

mild, moderate or severe.

In PEM muscle wasting is seen in all cases with hypotonia, hyporeflexia and delayed motor milestone in 15-45% cases. Occasionally proximal muscle weakness is noted. Electrophysiology study done showed evidence of sensory motor polyneuropathy. Severity of myelin and axonal loss parallels with severity of PEM (11-12).

***Vitamin deficiency and nervous system*:** A number of factors in the B group of vitamins are of clinical importance with regards to neurological disease. Although each is considered separately below, in many instances deficiencies of these and other vitamins occur in combination and may lead to complex clinical distribution.

Thiamine (Vitamin B1): Thiamine pyrophosphate serves as a coenzyme in oxidative decarboxylation and cofactor in trans-ketolation. Deficiency of thiamine in animals results in accumulation of lactic acid and reduction in oxygen uptake and depression of trans-ketolase activity especially in brainstem (13). Thiamine deficiency studied in developed countries in chronic alcoholics easily transposed to those in nutritionally depleted non alcoholics.

Two disorders that appear most clearly related to thiamine deficiency are nutritional polyneuropathy and the Wernicke-Korsakoff syndrome.

Nutritional polyneuropathy: Nutritional polyneuropathy is the most common of all nutritional disorders of nervous system. Clinically, it is symmetrical, mixed sensorimotor neuropathy affecting lower limbs much more than upper limbs. Signs and symptoms of dysfunction of autonomic nervous system are sometimes encountered as well, including vocal cord paralysis with hoarseness, dysphagia, pupillary abnormalities, and hypotension. Hyperhydrosis of hand and feet is common.

Electrophysiological studies reveal findings suggestive of axonal polyneuropathy (11). Pathologically the primary change is segmental demyelination with axonal degeneration, affecting distal portion of the peripheral nerves. In long standing cases, retrograde changes may be found within the spinal cord.

Restoration of a well balanced diet with supplemental of thiamine is the keystone of therapy. Thiamine is given parenterally initially at 50-100mg/day then orally for several days. Symptomatic

treatment with amitryptaline, pregabalin and carbamazepine is required. Recovery is variable depending upon chronocity**.**

Wernicke-Korsakoff Syndrome: Traditionally looked on as two distinct entities, they are best regarded as representing simply two aspects of the same disease, seperable chronologically into acute (Wernicke's encephalopathy) and chronic (Korsakoff's syndrome) phase (14). Thus the typical mental changes of Korsakoff's syndrome may be present from the early stages of acute Wernicke's encephalopathy. Furthermore examination of patients with classic Korsakoff's psychosis reveals residual features of Wernicke's such as nystagmus and trunkal ataxia.

Wernicke Encephlopahty: Wernicke's disease is an acute or subacutely evolving disorder. Appearing on a background of chronic or severe undernutrition frequently preceded by some additional metabolic stress like trauma or infection. Characteristic clinical features of this disorder include the following

1. Abnormal mental status which include apathetic, restlessness and drowsiness to hallucination, agitation and confusion.
2. Ophthalmoplegia - is the hallmark. Bilateral sixth nerve palsies are most common but any pattern of restricted ocular motility may be found. Diplopia is charectasticelly experienced.
3. Nystagmus – typically encountered in both the horizontal and vertical planes.
4. Ataxia- has both trunkal and gait ataxic with occasionally trunkal titubation.

The clinical course is dramatically altered by administration of thiamine (14-15). Within hour of the parenteral thiamine 50 mg, the ophthalmoplegia improves and ocular palsies generally disappear with in few days but nystagmus may persist. Trunkul ataxia recovers slowly. Patients are maintained on 50-100 mg of thiamine three times a day for several weeks. The disease can be fatal in 10-20 % cases. The pathology is mainly seen involving brain stem and hypothalamus. Lesions are seen in mamillary bodies, medial dorsal nucleus of thalamus in the periaquaductal gray matter and mesencephalon and in the superior cerebellar vermis. The characterstic lesion is subtotal tissue necrosis and hemorrhage in few involving neurons, axons and myelin to variable degrees.

Korsakoff's syndrome: This is a chronic from of Wernicke -Korsakoff syndrome and is characterized primarily by an amnesic dementia. The core of the defect appears to be an impairment of the ability to acquire new information. The patient tends to confabulate. The outlook for patients with established syndrome is discouraging. However, thiamine administration 50 mg three to four times a day is advised and in few cases though initial improvement may not be seen but over a period of months few show remarkably complete functional recovery. The neuropathological changes are identical to Wernicke's encephlophathy with only note worthy change being chronic form of glial reaction.

Niacin: Deficiency of niacin causes pellagra seen predominantly in India and South Africa. In its fully developed clinical form, pellagra comprises a host of symptoms referable to the gastrointestinal tract (diarrhoea, anorexia, nausea and vomiting), skin and nervous system. Both central and peripheral nervous systems may be affected.

Central nervous system involvement includes irritability to frank dementia. Occasionally extra pyramidal or cerebellar features are noted. Niacin deficiency can cause polyneuropathy which has mixed sensory motor involvement. Although it is widely held that the above features are due to niacin deficiency, the neurological changes are remarkably resistant to high dose of niacin even parentally. Associated deficiency of other vitamins like thiamine, vit B12 and pyridoxine may be important.

Pyridoxine (Vitamin B6): Neurological disorder reflecting both pyridoxine deficiency and excess has been recognized. During infancy pyridoxine deficiency results in seizure, excessive irritability, tremulousness and poor psychomotor development.

Deficiency of dietary pyridoxine causes a mixed distal symmetric polyneuropathy. The lack of pyridoxal phosphate as a coenzyme is responsible for neuropathy. Although the minimum daily requirement is only 2 mg, 50 mg or more may be required for successful therapy of deficiency state daily for one week then once a week for 4 weeks and then monthly.

Vitamin B12: Poor dietary intake of vitamin B12 as in malnutrition, extreme vegetarian, fish tapeworm infestation in addition to various other causes may lead

to serious disease involving both central and peripheral nervous systems.

The most widely recognized neurological disorder resulting from vitamin B12 deficiency is subacute combined degeneration of the spinal cord. Clinically presents as tingling paresthesias of the feet subsequently associated with weakness and stiffness of the legs and a spastic gait. It is an important cause for upgoing planters and sluggish or absent ankle reflex. It can present as pure axonal polyneuropathy (16) or pure myelopathy. Occasionally primary optic atrophy may be seen. A variety of mental changes may also be seen ranging from depression to paranoid states and most important progressive dementia.

On MRI, an increased T2 –weighted signal, decreased T2-weighted signal and contrast enhancement of the posterior and lateral columns of the spinal cord may be found in the cervical cord (17). Electrophysiological studies done to confirm polyneuropathy show mixed demyelization and axonal neuropathy. Treatment should be early and aggressive. 1,000 mg of cynocobalamin intramuscularly daily for 1 week and then once a week for 4 weeks, followed by monthly injection.

Folic Acid: Reduced serum folate levels have long been recognized in patients with subacute combined degeneration of spinal cord. Reversible depression and cognitive decline have frequently been reported in individuals with folate deficiency

Vitamin A (Retinol): A deficiency of vitamin A is remarkably common in many parts of the world, such as southeast Asia, Africa and the Middle-East where extreme poverty and nutritional depletion are endemic (18). Hypovitaminosis A leads most importantly to a variety of ophthalmic disorders, grouped under the rubric xeropthalmia. Early manifestation include night blindness, followed by conjunctival xerosis, Bitot's spots, corneal xerosis and keratomalacia. Hyperkeratosis and growth retardation is noted. Hypovitaminosis A can cause intracranial hypertension similar to hypervitaminosis A.

Vitamin A deficiency should be treated urgently. 200, 000 IU of retinol palmitate orally on two successive days which will reverse the clinical features.

Vitamin D: Deficiency of vitamin D causes rickets in children and osteomalacia in adults. Both rickets and osteomalacia are frequently reported in India. A deficiency in vitamin D has been held responsible, in part for the

weakness, fatiguability and muscular atrophy due to hyperparathyrodisim and renal tubular acidosis. Muscle weakness and tetany is seen secondary to hypocalcaemia. Minor myopathic features may be noted histologically.

Vitamin E: There has been growing awareness of the role of aquired vitamin E deficiency in neurological dysfunction (19, 20). A deficiency of vitamin E results in a remarkable constellation of abnormalities referable to both central and peripheral nervous system (21). Features of both spinocerebellar degeneration and polyneuropathy had been noted. In few cases seizures have been recorded. A lack of tocopherol has been demonstrated in peripheral nerves in vitamin E deficient patients.

Variable improvement in the clinical and electrophysiological parameter were seen after the administration of oral or preferably paraterally (50-100 mg weekly) for several months to years, but may not necessarily reverse the clinical symptomatology (22).

Other Vitamins

Pantothenic acid deficiency is a rare case of predominant sensory neuropathy. Deficiency of biotin can cause dementia, seizures and ataxia.

Trace element deficiency causes various neurological dysfunctions as shown in the Table 1.

Table 1 : Neurological and other manifestation of trace element

Element Deficient	Clinical Features
Iron	Anaemia, poor brain development
Zinc	Microcephaly, psychological disturbance, encephalopathy, congenital malformation
Copper	Anaemia, growth failure, mental deterioration
Cobalt	Features similar to vitamin B12 deficiency
Selenium	Myopathy
Iodine	Cretinism, developmental delay, deaf mutism
Magnesium	Myopathy

Nutritional Recovery Syndrome

During recovery of PEM mainly kwashiorkor following nutritional supplementation, the child develop coarse tremors, myoclonus, bradykinesia, rigidity, trunkal ataxia and up gaze palsy which are self limiting.

Deficiency Disorder of Unknown Origin

Infantile tremor syndrome

This is seen in north, central and north east India usually during Feb to July. This syndrome is exclusively of breast fed children between 6 to 24 months in poor socioeconomic population.Abrupt onset tremors and trunkal dystonia along with mental and physical retardation, pallor, hair and skin pigmentation are noted. This is self limiting entity.

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Neurobiology of Food Intake and Ecology of Hunger and Malnutrition

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ABSTRACT

The dual hypothalamic feeding-satiety centres, identified by Anand and Brobeck in 1951, laid the ground work to suggest that both detection and control of food intake was a central phenomena. In sixties it was realized that not only central structures but a variety of peripheral mechanisms are as critical and extend well beyond the classic sense of taste and olfaction and involve gastrointestinal signalisation, motivation and drive, and social and other environmental features. Later decades brought in implications of external features modulaing not only quantitative but qualitative components of feeding behavior, linked among other factors to ontogeny of feeding, nutritional profile of the individual, socio-economic influences and other environmental conditions. A more recent development has been the interfacing of disciplines such as physical sciences, agriculture, food sciences, economics, social and environmental sciences, information technology and others. It would appear that control and regulation of food intake is a multilevel, multifactorial closed feedback system with several stages ranging from afferent synthesis to stages of decision making and leading to levels of behavioural acts becoming imperative and satisfying specific needs.

Keywords : Neurobilogy of food intake, feeding and satiety centres, hunger, metabolic and energy pool, environmental factor in food intake, malnutrition.

Introduction

The classical paper of Anand and Brobeck in 1951 (1) identifying the dual hypothalamic feeding –satiety centres, showed that tiny discrete lesions of specific, localized zones in hypothalamus bring about aphagia or hyperphagia and obesity, depending upon the site of the lesion. This pioneering work set in motion a number of studies with the main stream of thought during fifties

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being that both detection and control of food intake regulation lay in the central nervous structures in which hypothalamus plays a major and decisive role. In the sixties it was gradually realized that though hypothalamus plays such an important role, this itself is not only influenced from higher limbic and other central neural regions but is modulated by several factors such as nutrition itself, motivation and emotional factors, sensory qualities of food and hedonic matrix, as also the signalization particularly from oral and gastrointestinal level. The appraisal of food includes its taste, flavor, texture, viscosity, volume, temperature and other physicochemical characteristics.

Still a number of questions remained unanswered and pointed to the existence of peripheral mechanisms extending well beyond the classic sense of taste and olfaction, and extended to cover motivation and drive, social and environmental context and formed the major thrust of research activities in seventies and eighties. Later decades brought in further implications of external features modulating not only quantitative but qualitative components of feeding behaviour linked among other factors to ontogeny of feeding, the nutritional profile of the individual such as undernourished, obese or malnourished subjects, the sociocultural and economic influences, religious taboos or environmental features ranging from high altitudes, arid zones, desert areas or arctic / antarctic climatic requirements to extreme tropical climate. A more recent development has been the interfacing of disciplines such as physical sciences, agriculture, food sciences, economics, social and environmental sciences, information technology and if I may say the addition of politico-economic influences by acknowledged Global Institutions and Agencies.

Orogastric Appraisal

Oral sensory appraisal of food is the first step in feeding and leads to its acceptance or rejection, and when accepted, is eaten in definite amounts. Through the second step of action of foods in feeding process, these orally determined responses to food are regulated. At the post absorptive and systems level, food as a nutrient, acts as a metabolic signal on the regulatory centres and 'modulates' oral feeding responses (2). The sensory signals not only become important in controlling intake, but feedback into the efferent system controlling the 'energy pool', producing some of the metabolic changes originally controlled

biochemically at cellular level, and behaviourally signaling satiety. Thus satiety cues are produced in two phases, first as anticipatory reflex, initiated by the taste of food, and secondly by the post absorptive metabolic consequences. The flow of information from alimentary afferents has shown a number of features influencing gastro-gustatory interactions in taste (3-6). It is quite likely that the changes seen in intakes of sweet and salt solutions in vagotomised animals are predominantly due to loss of vagal afferents from the stomach (7). The flow of information from the alimentary receptors to the brain, are not all in one direction but is rather achieved by 'tuning' of the receptor systems through use of centrifugal controls. These controls allow sensory pathways to act as variable filters so that stimuli tagged with a particular attribute or feature are alone allowed through for a detailed analysis. By such means it is possible to attenuate or amplify afferent signals, or switch on or off the inputs, thereby selecting a particular input at a particular time. It seems these gastric and intestinal sensory mechanisms, are concerned with the 'sensory' appraisal of food including its texture, viscosity, volume, temperature, and other physico-chemical properties of food, and share in large measure the organizational control characteristics of oral sensory system (8, 9).

Ontogeny of Feeding

Ontogenetic analysis suggests that each stage of development appears complete. Observations on ontogeny of saccharine preference in neonate rats clearly pointed that the apparent learning curves for saccharine, were infact maturation curves (10) and were linked to the maturation of gustatory system (11). It appears that neonate is primarily dependent upon 'taste', rather than 'calories', a feature also seen in adults under certain conditions of nutritional stress, food deprivation, metabolic disorders and psycho-sociocultural overtones. Need-related changes in palatability and taste sensitivity are well known and have been shown in normal adult rats and dogs, hypothalamic hyperphagic rats as also in neonate rats (12). Neonate rats can eat enough at least to double average growth rate if competition for food is eliminated by limiting the litter size. It is suggested that young rats lack active satiety systems (13).

An alternative possibility has also been proposed. Our approach has been to vary hunger by mealtime restriction, graded food deprivation, insulin or thyroxin injection. Food intake and preference shifts were, then observed to 'liked' items, e.g. fat, glucose or saccharue or 'disliked'

items like cellulose, NaCl or quinine which were added to stock diet or put into solution. The results show that need-related changes in palatability and taste sensitivity are basically present all the time and are modulated linked to the prevailing circumstances. This is interfaced with developmental changes in the taste receptors and CNS, and in physiological and behavioural patterns in fetus and postnatal animals. Tongue epithelial cells are modified into taste buds only with innervations and are seen to degenerate on denervation. This in turn seems to show gradual transitions in electrical responses to taste stimuli from foetal to adult stage. Behaviourally, human foetus and neonatal mammals showed increased swallowing movements on sweet taste and decreased movements with bitter taste which is somewhat at variance with electro-physiological evidence and reflects on the multimodal involvement of taste cell functional and behavioural dynamics with age (14).

Multilevel Signals Related to Food Intake

The fact that the changes introduced in the internal environment by the feeding ultimately adjust subsequent feeding (15,16) places control of food intake in the same category as the control of various other visceral activities. The pattern of control of visceral activities is similar in many ways and parallel to that of somatic activities. The sensory inputs come from various regions of the body which make the animal aware of food. The hypothalamus provides quantitative control by 'facilitating' or 'inhibiting' feeding reflexes. Further, discriminative control of food intake is influenced from limbic level, and habit and conditioning from the neocortical regions (15). This scheme exemplifies the organization of neural substrates encompassing peripheral receptor mechanisms and interconnected systems situated at several levels of neuraxis. Through the functioning of these multiple neuronal systems the integration is achieved so that the organism is directed to the fulfillment of biological needs. Thus, the concepts of 'multiconstancy', 'multifactors', and 'multilevels' are all enshrined in the idea of homeostatic control of food intake (8), and indicate that the multilevel analysis, priorities, and competitions are essentially linked to internal (energy pool) and external (environmental) factors. This analysis of location, internal state and stimulus variety provides a basis that must be taken into account in any model of food intake regulation.

How does high altitude stress effects human taste intensity and hedonics? We conducted an extensive study on

human volunteers at high altitude. The taste intensity ratings showed a linear relationship with increasing logarithmic molar concentration of each solution (sweet, sour, salt, bitter) as compared with taste hedonicity which showed an inverted 'U' type function. High altitude hypoxic stress brings about changes in hedonic responses, primarily an increased palatability for sweetness and suggests that the mechanism may be anorexia – linked nutritional stress. The high altitude stress appears to influence food intake in a manner that sensory cues (e.g. preference for sweet substances) become more important. (17,18).

The studies were also conducted to evaluate the effect of continuous exposure to hypobaric hypoxia on the feeding behavior and taste responses of rats, under simulated conditions of high altitude of 7,620m for 21 hours a day and consecutively for 18 days, which more closely resembled actual field conditions. The results showed a decrease in daily food and water intake and body weight and a preference for sweet solutions. High-altitude stress appears to influence food intake such that sensory cues assume greater significance during feeding behavior, and thus supported the observations obtained in humans at high altitude (19).

Dual Detector System

What are the consequences of food ingestion? How does an organism being fed adlib or under conditions of food deprivation, or in varying states of hunger, handle the information from dietary source. How does in fact the state of 'energy-homeokinetics' – surfeit or deficit state, interface with external dietary and environmental cues to guide the feeding behavior? How indeed feeding fits in the domain described under the rubric of homeostatic motivations? These and allied questions have attracted the attention of several workers during the last few decades.

It seems physicochemical information from the diet feeds into two detector systems – sensory and metabolic systems (Fig. 1). Whether the nervous system makes use of either set of signals in monitoring further intake is a function of the state of energy balance. The 'energy pool' acts as a biasing system, assigning priority to taste (sensory qualities) when the animal is in a deficit and to calories (metabolic properties) when it is in balance or surfeit (Fig. 2). The assumption is that organic needs alter perceptual bias on an innate basis so that animal seeks out and ingests the needed food on the basis of its sensory qualities. The fact that

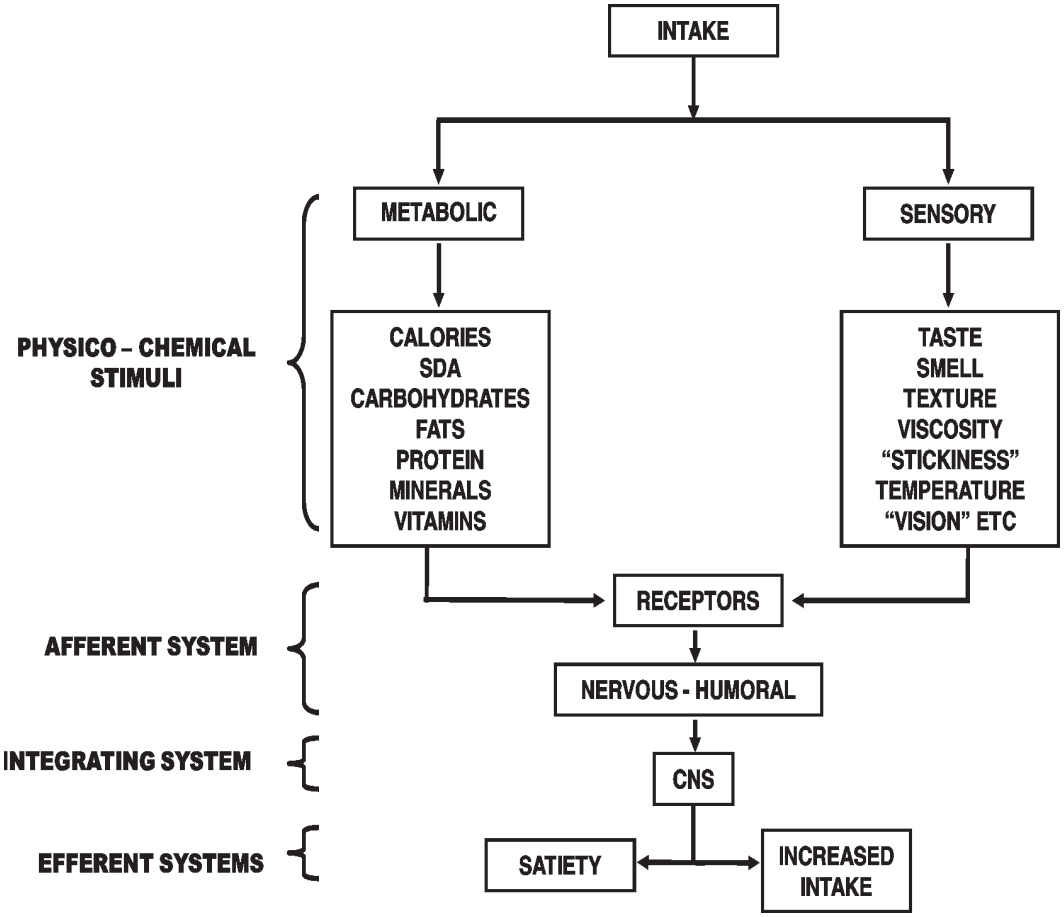

Fig. 1: Generalized scheme of sensory and metabolic feedback systems in food intake (23).

food contains nutrients is considered coincidental (20,21,22).

There has been yet another important dimension added as a result of the studies in sixties and seventies. Two problems have been separated – control of input and regulation of energy level. Available diet provides both sensory and nutrient signals that the brain in turn compares to other signals coming from the energy – nutrient pool, which provide information about the sensory and metabolic consequences of these nutrients (23). The brain then uses this information in modulating food intake or learned food related behaviours. It is easy

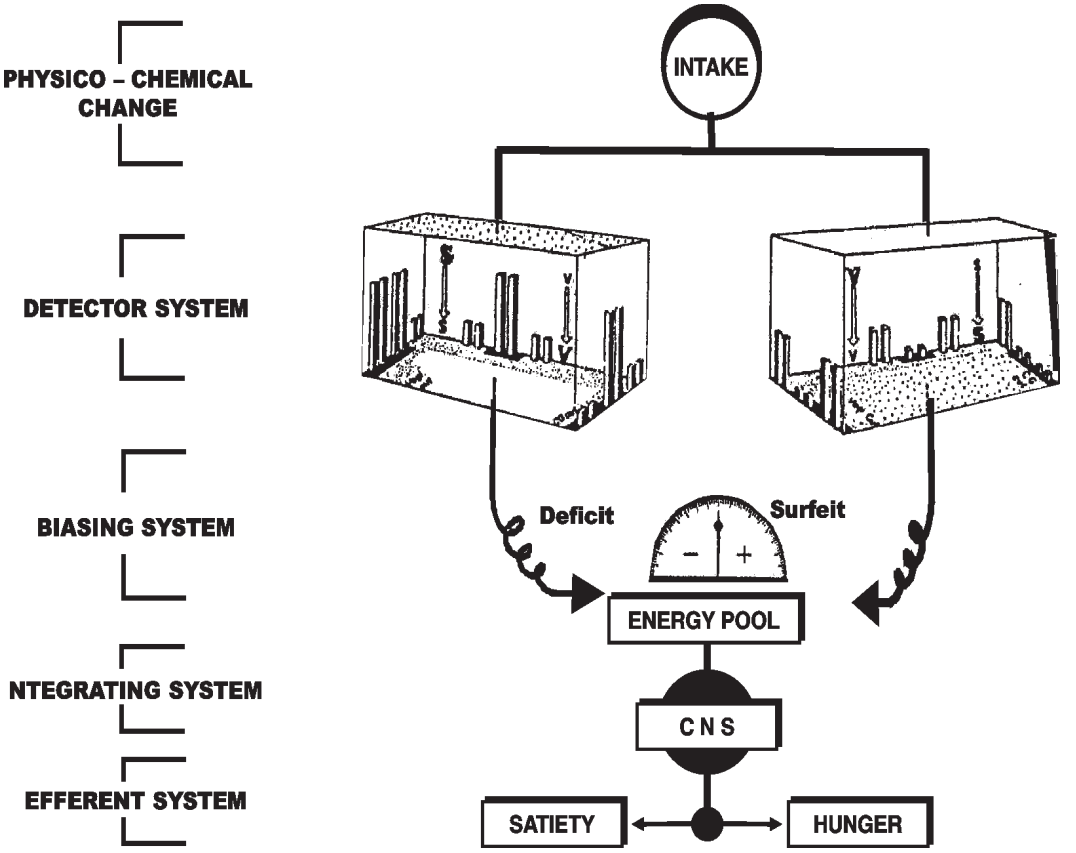

Fig. 2: Model showing the dual detector system and the role of the energy pool as a biasing system, in the overall control of food intake (From: Sharma et al. *J Neural Transmission,* **33:** 113-154, 1972).

to see that the combined action of gastric emptying time, intestinal absorption rate, efficiency of food utilization and metabolic activity, and the behavioural output of muscular work and general activity can be important in regulating the energy – nutrient pool. Thus in this scheme, body weight is not only influenced by food intake and changes in output, but also by taste-induced appetite shifts from energy nutrient pool (Fig. 3).

Recent Studies

During the last two decades or so, systems approach has been applied inkeeping with the technological advances, and include role of emotions and motivations, neuro-humoral

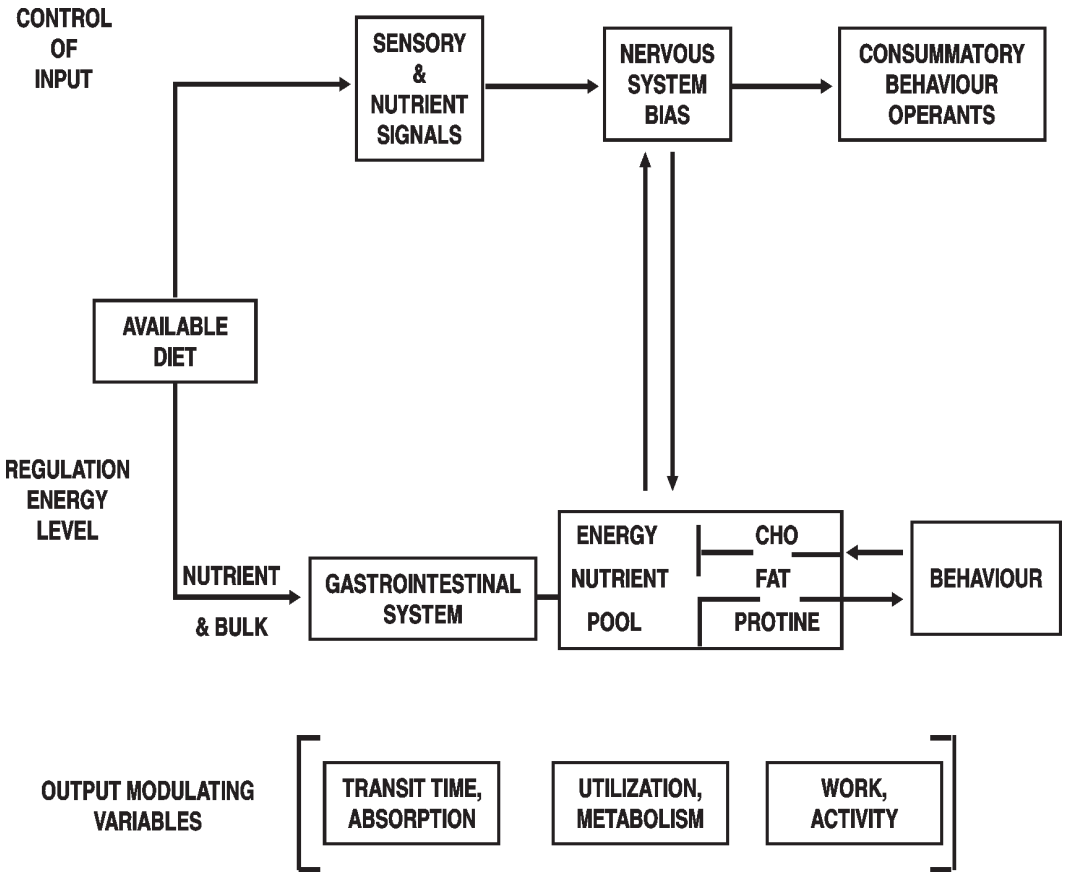

Fig. 3: Scheme of input control (top) and energy regulation (bottom) as interacting systems involved in homeostatic regulation of consummatory behavior (From: Sharma KN, In: Advances in Physiological Sciences, New Delhi: Macmillan India, pp. 639-647,1992).

networking, and unraveling of intimate mechanisms involved in control and regulation of feeding, so as to give a more detailed holistic picture. In this complex organization of systems approach, afferent synthesis forms the first step in which juxtaposition, selection and synthesizing of functionally diverse inputs linked to the dominant need, past experience or memory, simultaneous presence of other afferent stimuli, and straight through hotline passage of information are all taken into consideration (Fig.4). This stage then determines the subsequent stages of the systems organization of the behavioural

act and underlines the formation of purposive behavior crucial for survival and adaptation, and show a well defined line up of hierarchical dependence (20).

The next stage bring into focus the preparedness of the individual and triggers the behavioural response activation time and determining the whole act to include initial and subsequent stages of decision making, formation of mechanisms of predicting results, and satisfying the specific needs. Interlinked with this is the next stage of decision-making in a manner that the behavioural act becomes imperative, and shapes the significance of resultant activity in need reduction or satisfaction,

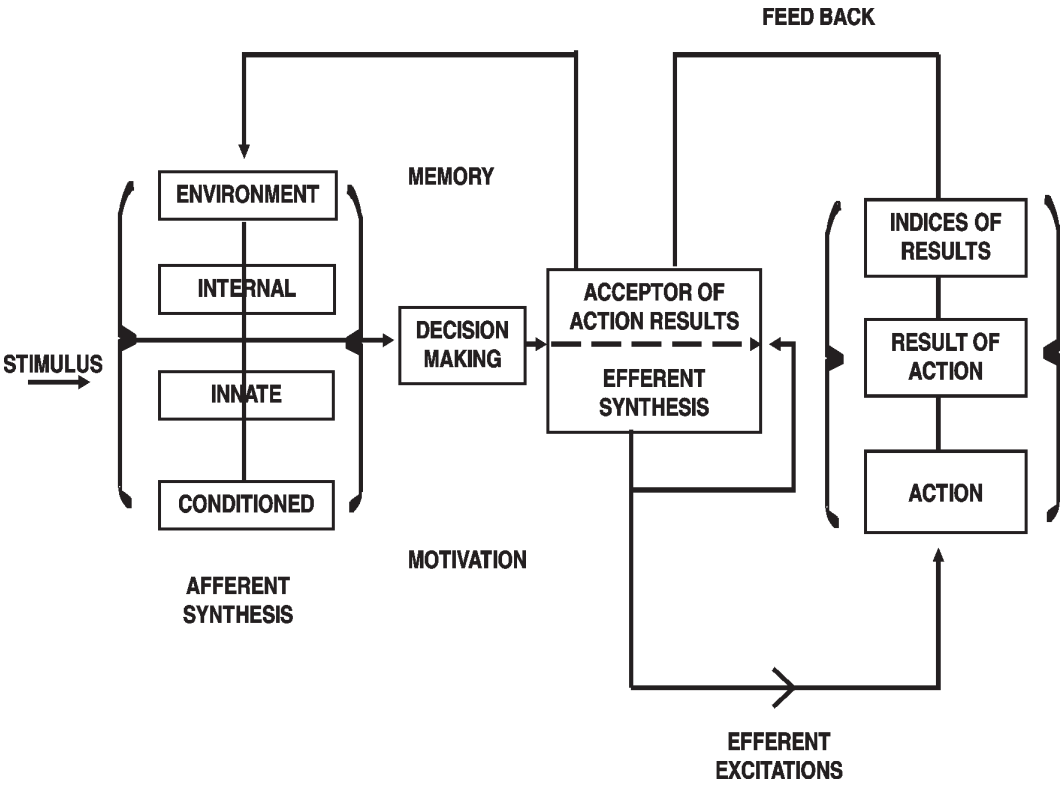

Fig. 4: Schematic block diagram showing various interlinked and interacting stages depicting the relationship of stimulus characteristics, afferent synthesis, decision making, efferent excitations, and the role of feedback control system and memory mechanisms in guiding the motivational behavior (From: Sharma KN, In: Advances in Physiological Sciences, New Delhi: Macmillan India, pp 639-647, 1992).

correct behavioural errors and bring about behavioural acts to their precise end point.

Thus it would seem that food intake is regulated by a closed-feedback system, with regulated input as well as output. There is a distinct relationship between sensations (eg. hunger) and drives (eg.food intake). Stimuli (internal or external) adequate to elicit a sensation also elicit activities directed towards reducing the intensity of such sensations. In other words, the stimuli for those sensations induce motivational states that drive the individual, to provide whatever is felt to be lacking. Viewed in this respect, physico-chemical signals from food form a base that controls food acceptance, choice and intake (8). The interfacing of these signals with the changing needs of the individual, include the concept of priorities, competition and compromises in regulation of several factors contributing to homeostasis (20). The fact an identical stimulus may be handled differently by the nervous system depending upon the variety and the complexity of the existing variables, is all well enshrined in the capacity and the plasticity of the nervous system and linked to the requirements of internal and external environment (23,24,25).

Econutrition

With this background let me bring to your attention another perspective which is becoming important and relevant as never before. Do we not realize that traditional agricultural and food sciences disciplines have to dovetail with human nutrition and health by forging explicit linkages not just in a linear fashion but in a truly integrated manner, and use food-based, systems approaches to meet human nutrition goals. For instance, the current focus on micronutrients for people globally may form a part of the effective inter-disciplinary research, teaching and extension activities directed towards sustainable improvements in human nutrition and health. In this task the paradigms of agriculture, human nutrition and public health, will have to be shifted from linear approaches to integrated and interactive long-term efforts. In other words econutrition should integrate environmental health with human health with a particular focus on the interactions among the fields of agriculture, ecology and human nutrition, and thereby help alleviate not only extreme poverty but would appear also fundamental to linking basic sciences understanding in multiple areas. Can we ignore the relationship between environmental degradation, develop-ment, world poverty and hunger

and social justice. The struggle to preserve the environment is unavoidably intertwined with the struggle to improve the conditions under which the poor of many third world countries live.

Put in other words, as Kristensen argues (26), hunger, satiety and appetite can be seen as a central research subject for the social sciences, both as the locus where food consumption is bodily regulated and the nexus where biology, social praxis and cultural meanings meet and are negotiated by the individual. For instance, the number of people developing overweight and obesity is increasing as is the prevalence of eating disorders and weight preoccupation. These tendencies can be considered as expressions of a polarization of eating habits in modern societies. These tendencies could as well be seen as a result of a more general ambivalence in relation to food, which influences the experiences of hunger, satiety and appetite and their regulating effect on food consumption. It would be worth exploring to link traditional agricultural production disciplines to the food sciences and the various disciplines concerned with human nutrition. Cornell University has developed a new programme to cover 'Food Systems for Health', and fosters effective inter-disciplinary research, teaching and extension activities directed towards sustainable improvement in human nutrition and health (27). Similarly, the United Nations Millenium Development

MDGs sets targets related to important global poverty, health and sustainability issues, and seeks to improve survival through environmental and nutritional interventions (28). For instance, to estimate the reduction in child mortality as a result of interventions related to environmental and nutritional goals like improving child nutrition and providing clean water, sanitation and house hold fuels, coupled with the magnitude and distribution of the effects of interventions vary largely based on the economic status of intervention recipients, and therefore calls forth for an integrative approach which should prioritize the poor.

Implementing interventions that improve child nutrition has shown considerable reduction in child mortality as shown by the results from Latin America and the Caribbean, South Asia and Sub-Saharan Africa, and indicated that the three regions show larger than expected improvement if the interventions are implemented among the poor first, and this needs to be emphasized and taken note of. Contrast this with the aggregate human impact

on the environment now exceeding the limits of absorption. The resultant global environmental changes include altered atmosphere composition, widespread land degradation, depletion of fisheries, fresh water shortages, and biodiversity. Disturbances of the Earth's life-support systems will affect disproportionately the resourcepoor and geographically vulnerable populations particularly in many tropical countries, and lead to, among other hazards, to food insecurity and water stress, thus causing various health consequences.

In short, as Jaffe (29), summarises, there are a variety and complexity of factors which in one way or the other influence on the selection and acceptability of foods such as:

(i) physiological and psychological aspects, to include genetic factors, neurophysiological factors, emotional factors, perceptive factors; and

(ii) at another plane, physical and ecological aspects; or

(iii) the domain of social and cultural aspects – habits and traditions, religious believes, taboos, nutrition faddism; prejudice, aversions and pervertions; social value of food, industrialized foods, or

(iv) at still other plane, economic aspects, and

(v) finally the frame work of educational aspects.

It would therefore be safe to conclude that feeding behavior is regulated by a multiple-sensor, closed-feedback system, with regulated input as well as output. The driving biological need, linked to the internal physiological deficits or biologically relevant events in the external environment is reflected in the changes in different major homeostatic indices determining the normal metabolism, and interact with the environmental factors to form the basis of the biological motivation. There is a distinct relationship between sensations (e.g. hunger) and drives (e.g. food intake). Stimuli (internal or external) adequate to elicit a sensation also elicit activities directed towards reducing the intensity of such sensations, i.e. the stimuli for those sensations induce motivational states that drive the organism, to provide whatever is felt to be lacking. Viewed in this respect, chemosensory signals from food provide the sensory basis of hedonic matrix that controls food acceptance, choice and intake. The interfacing of these signals with the changing needs of the organism, include the concept of priorities, competition and compromises in regulation of several

factors contributing to homeostasis. The fact that an identical stimulus may be handled differently by the nervous system depending upon the variety and complexity of existing variables or the capacity of the nervous system to make continuous appraisals and instant decisions in order that the organism can react in strict accordance with the requirements of internal and external environment and should form a base for us to follow. This is the central message.

It would thus become clear that in this closed feed back system regulating food intake, afferent synthesis is the first stage. This afferent synthesis leads to the specific states of readiness in which both motivation and environmental stimuli interact as activated by memory mechanisms and bring into focus the preparedness of the organism. This in turn leads to triggering of the behavioural response activation time and determining the whole act to initial and subsequent stages of decision making, formation of mechanisms of predicting results, and satisfying specific needs. Dovetailed with this is the next stage of decision making in a manner that the behavioral act becomes imperative and bring about behavioral acts to their precise end point. Some of the recent findings have laid a fairly good groundwork indicating that the control and regulation of sensory and metabolic events resulting in the particular feeding behaviour, may come from higher levels of the same sensory pathways, from motor pathways, from pathways mediating other modalities and a number of other sources. Extending these studies further to neuronal level, it could be seen that sensorimotor cortical neurons (SMC) would show excitatory responses in hungry animals when Lateral Hypothalamic (LH) neurons were stimulated and the animals would vigorously eat food; but if the food was withheld and not presented to the animal, the same SMC neurons now showed an inhibition rather than excitation (25). These types of results quite clearly indicated that there was reorganization of neuronal activity for decision making and thereby differentially influencing the motivational and reinforcing components of the composite feeding behavior. Extending the work to humans it has become clear that nutritional background (internal state), previous dietary history (ontogeny of feeding), and external environmental factors interact in such a way that the prepotent sensory properties of food and experiential factors subserve to bring about relevant metabolic adaptive changes, taste preferences, and food habits.

In conclusion, it may be surmised that whether the sensory or the metabolic cues become prepotent to guide the motivational behavior towards need reduction or homeostatic regulation of feeding, is a dynamic process in which both sets of cues ie sensory or metabolic cues, are involved, and it is the interaction of internal milieu with the external environmental factors impinging upon the innate and experiential correlates which appear to determine the degree and the direction of feeding behavioural act, visa vis nutrition and energy balance.

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Changing Trends in Medical Education - An Overview

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ABSTRACT

For the past several years, the state of medical education remained more or less static in India, with a few exceptions by institutions trying to carry out certain educational reforms in teaching and training. In recent times, socio-economic conditions and several other factors, including technological developments which either directly or indirectly influence the health care delivery systems have made strides. Hence there is an urgent need for all the stake holders in medical education to bring about the much desired pedagogic shift from traditional approach to a need-based approach, so that the medical education becomes more meaningful and useful. To achieve this in the present scenario, attention should be focused on the changing trends and strategies to be followed to cater to the needs of the health care delivery system and the society. An over view of these trends or innovative strategies that are being tried globally are enlightened along with future directional approach to this complex issue. However, this requires, in addition a fundamental change in the roles and commitments of educators, planners and policymakers.

Keywords : Medical education, changing trends, trends in medical education, medical curriculum, integrated medical teaching.

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Introduction

The evolution of medical education in the World goes hand-in-hand with the evolution of mankind and it is considered as an art of acquiring and retaining knowledge of medical subjects and practical skills or competencies required for the treatment of the patient. The basic theme of medical education is to improve the quality of health care delivered by doctors. Young medical professionals of today will have to encounter certain challenges in their professional career such as keeping in touch with the continuous explosion in scientific knowledge particularly in information technology and molecular biology. There is also the need to choose appropriate diagnostic tests among the plethora of tests available and to diagnose correctly, the need to bestow specialized attention to ever-increasing geriatric problems due to increased life expectancy and the availability of improved therapy, increasing incidence of psychiatric disorders, ethical dilemmas, and last but not the least is the changing physician – patient relationship and patient expectations. The practicing physician of today is also required morally and even legally to stay updated on recent advances in the medical field so that he can provide quality medical care.

Hence, the medical curriculum has to be changed or modified regularly to prepare the young physician entering lifetime practice. Many authorities stressed the need for a change in the educational programs of medical education and have provided the main impetus and imperatives for the changing trends by way of suggesting different strategies in this direction (1-4).

The need of the hour is to adopt innovative strategies and trends that can focus on self-directed learning, problem-based learning, competency-based learning, early clinical contact and contact with all types of health care services available in the community so that these educational programs become learner-centered. These changes are needed to prepare doctors to fulfill the expectations of society and to cope up with exponential growth of medical and scientific knowledge and inculcate the habit of continuous learning and ensure basic knowledge in information technology and to adjust the modern education system to the changing needs of health care delivery system. The medical teachers should be involved in the educational preparation of medical students at every level to ensure that the desired quality of the end product of medical education is produced. The change in attitudes is also required

among all stake-holders including those who govern and participate in medical education. The changing attitudes of the society and the student community, the emerging educational technology, besides governance and leadership issues to tackle resource mobilization should be taken into account in a systematic manner while planning and management of innovative educational programs (5).

Current Status of Medical Education in India

Most of the medical colleges in India with few exceptions are finding it difficult to maintain the right quality and quantity of medical education. For the past few decades, not only academicians but also the public have been expressing serious concern over the deterioration of standards of medical education in India (6). Although, the existing medical education system in India produced several excellent doctors who made their name both nationally and internationally, a closer examination of the education pattern show that present system has failed in serving the country in many aspects. The medical graduates who come out of the colleges are not trained well or equipped to deal with problems that they would face in the society. Medical graduates are not well conversant with ethical issues and not exposed adequately to take a leading part in improving the health of the nation. The standard of medical education has gone down to such an extent resulting in that if appears as if modern day doctors rolling out are from a conveyer belt system. During the last few years yet another force, "Market forces" has emerged and is further threatening the standards of medical education and the investments in privatization of health care has relegated teaching and research to secondary activity (7,8).

Current situation demands that medical graduates coming out of colleges should have fair knowledge of human body, mind and its diseases, about diagnosis with or without diagnostic aids, and start treatment if within his field of competence, otherwise refer the patient to a specialist. The doctor must have compassion for the patient and respect ethical values. In the current scenario existing in the country, there is an urgent need to incorporate the changing trends described in all the medical educational programs all over the country to bridge the gap between the theory and practice and to maintain much desired uniform standard of medical education.

Curriculum Reforms

A curriculum is considered as a formal educational plan, comprising of

goals and objectives to meet the identified needs, their implementation through the educational activities with a provision for evaluation, feedback for continual improvement in the educational process. During the last several decades the medical educationists have done very little to correct the major shortcomings in the curricular development that were pointed out and discussed repeatedly. The existing undergraduate curriculum in India is mainly based on the knowledge accumulated both in basic as well as in clinical sciences. It has become not only ineffective in preparing the students of tomorrow but also contributing to the problem of information overload due to rapid advances in science and technology.

The National Health Policy (1983) of the Government of India, while recommending the formulation of a National Medical and Health Education Policy, provided direction to restructure the undergraduate curriculum to train Primary Care Physician capable of providing essential health care services to the rural population. In 1986, Indian medical schools consortium recommended a revised curriculum, defining the departmental objectives, classifying the course content as 'Must Know' and 'Desirable to Know', and compiling a list of essential skills required for a Competent Primary Care Physician (7). In 1997, the Government of India, on the recommendation of the MCI, promulgated the Regulations on Graduate Medical Education (9) stipulated that undergraduate medical education should be oriented towards health and community as opposed to disease and hospital and the graduate must develop humanistic qualities in discharging professional obligations and be able to function as leader of the health team either in urban or rural settings. To meet this end, students' training must aim at inculcating scientific temper, logical and scientific reasoning, clarity of expression, and ability to gather and analyze information.

To overcome the problem of factual information overload, it is recommended to adopt the concept of "Core curriculum" by encompassing the essential knowledge, skills and appropriate attitudes to be attained by the graduates. It should be augmented by a series of special study modules, which allow students to study areas of particular interest to them in depth. The core curriculum should be system-based and integrated, to break the rigid pre-clinical/ clinical and departmental boundaries. Basic science teaching should be relevant to the overall objectives of the medical course and its relevance should be clear

to the students. Mastery of the core ensures the maintenance of standards; the options provide in-depth work and achievement of high-level competencies such as critical and generic competencies or transferable personal skills which include bio-ethics, communication skills, interpersonal skills, problem-solving ability, decision-making capability, management and organization skills, working in team, IT skills and doctor-patient relationship, essential to their roles as health professionals (10). However, the postgraduate curriculum in particular needs to be constantly revised and updated in keeping with advances in scientific knowledge, inventions in the field of medical education and changes in the epidemiologic pattern of diseases and the needs of the community to manage diseases that exist and also the emerging and re-emerging ones.

Integrated Teaching

Most of the medical colleges in our country continue to follow the traditional subject-based curriculum wherein the subjects are taught in isolation with little or no attempt to integrate the basic sciences with the clinical disciplines. Severe dissatisfaction is being expressed over this method of training since it is found that this system is wasteful (because of unnecessary repetition), disjointed (because of isolation from other 'subjects'), and confusing (because of departmental differences of opinion) and ineffective for producing a competent doctor. In early 1950s, In the USA, Cape Western Reserve University initiated an organ-system based curriculum, in which the old divisions between preclinical and clinical teaching were swept away and attempts were made to integrate the teaching of both the basic and clinical sciences throughout the students' careers (11). Such an integrated curriculum provides a meaningful learning experience as learning takes place in a context (contextual learning). It also promotes a holistic approach to patients and their problems. A move towards integrated teaching is likely to reduce the fragmentation of the medical course and motivate the students for better learning (12).

The integrated teaching can be done in two ways - Multi-professional and Multi-disciplinary. In Multi-professional, approach, students of different professions such as medicine, dentistry and nursing are taught together on some common subjects. This helps the student to share the knowledge and skills and enhances personal and professional confidence, helps attaining respect between professionals, promotes

reflective practice that ensures quality of health services. The Multi-disciplinary approach is done either by horizontal or vertical methods of teaching. Vertical integration is found to be more effective than the horizontal integration on account of early introduction of students to clinical material along with the basic sciences throughout the undergraduate program. This strategy is more effective in preparing the students for their future careers in view of early clinical contact (13, 14). Medical Council of India recommended both horizontal (e.g., anatomy-physiology-biochemistry) and vertical integration (e.g., anatomy with surgery) to be introduced throughout the curriculum (15). In an attempt to promote small-group learning, greater emphasis on health and community, problem-based learning approaches, and horizontal and vertical integration, the regulations on Graduate Medical Education for curricula were substantially revised in 1997 (9). Although integrated method of teaching is advocated by the MCI regulations, discipline-based teaching continues to remain the predominant mode of education due to several problems like departmental compartmentalization, lack of integrated course material in the departments and poor coordination between pre-, para- and clinical disciplines.

Learner-centered Approach

Currently, in most of our institutions, the undergraduate training is through didactic lectures by the teacher, which only encourages superficial or examination oriented learning by the students. This type of training having been exposed to lot of criticism has paved way for the shift from the pedagogic traditional teacher-centered approach to a student-centered approach. This alternative method of learning is an active process where the student learns through his own efforts or study and the teacher acts as a guide.

Such a Self-directed learning enables him to define his learning needs, formulate the goals, identify the human and material sources for learning, and choose appropriate learning strategies. This process, the student being an active participant, encourages in depth learning and enables him to use his learning relevant to his educational needs. The style and manner of learning can pace his learning appropriate to his ability to understand particular area (16). It is now being considered as the most effective approach in medical education and many strategies have been developed to provide self-directed

learning such as problem-based learning; discovery learning; task-based learning; experiential and reflective learning; portfolio-based learning, small-group, self instructional and project-based learning (17).

Problem-Based Learning (PBL)

Of these strategies, The Problem-based learning (PBL) has been recognized as the most important development in medical education. The principle of Problem-based learning (PBL) is based on the educational philosophy of the French educationalist; Célestin Freinet in the 1920, and is used in many subject areas including Medicine. Problem-based learning adapts learner-centered method where the students in small groups learn while working on real-life problems, activities, and teacher acts as a guide. The problems are used as a focus for learning basic sciences and clinical knowledge along with clinical reasoning in an integrated manner that follows a particular sequence such as Maastricht 'seven jump' (17).

Maastricht "seven-jump" sequence for problem-based learning is:

1. Clarify and agree working definitions and unclear terms and concepts.
2. Define the problems; agree which phenomena need explanation.
3. Analyze the problem (brainstorm).
4. Arrange possible explanations and working hypotheses.
5. Generate and prioritize learning objectives.
6. Research the learning objectives.
7. Report back, synthesize explanations, and apply newly acquired information to the problem.

The advantages of problem-based learning over the traditional learning methods of teaching are:

- Promotes deep learning rather than surface learning.
- Enhances and retains self directed skills.
- Learning environment is more stimulating.
- Promotes interaction between the learner and instructor.
- Provides collaboration between disciplines.
- More enjoyable for students and teachers.
- Promotes retention of knowledge.
- Improves motivation.

It is a systematic attempt to apply findings of cognitive psychology to educational practice (18). The Medical

School at Maastricht has taken a leading role in the development and application of active learning strategies and the WFME and the WHO have endorsed PBL as an educational strategy and several institutions all over the world have adopted this method of pedagogy (19).

Evidence-based Medical Education

Evidence-based medical education (EBM) is the practice and implementation of method and approaches to education based on the best evidence available to teachers in their practice. It is based on the evidence gained from the scientific methods and it also seeks to assess the quality of the evidence relevant to the risks and benefits of treatment (20).

In EBM, the student / consultant should be able to do an appropriate literature search, identify the literature evidence available on the clinical condition and evaluate the same critically and determine the "best evidence" to diagnose / treat / manage the patient, in the shortest possible time in an efficient manner. The practice of EBM is becoming more important since the internet revolution has brought access to these medical databases to the common man and the patients' access to the databases would also increase their expectations. Thus, e.Learning through databases and electronic versions of text books provides an important forum for EBM teaching and learning and its role is likely to expand in the future and it may become impetrative for the clinician to adopt the practice of EBM.

Further EBM will promote the "Best evidence medical education" (BEME) utilizing the research findings. Curricular changes made are to be ensured that they are evidence –based and should encompass all dimensions of medical education. All health care professionals need to understand and implement the principles of EBM to improve care of their patients. Interactive and clinically integrated teaching and learning activities provide the basis for the best educational practice in this field (21).

Competency-Based Medical Education (CBME)

Competency-based education is an approach to instruction and assessment in which the main emphasis is placed on identifying and measuring specific learning outcomes or competencies. Professional competence is defined as the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and the

community being served. Competencies are outlined clearly as real-life abilities needed for carrying out professional practice effectively and is the basis for determining the curriculum content and its organization, teaching and learning methods, course contents, assessment modalities (22).

The Accreditation Council for Graduate Medical Education (AGGME) in 1999 identified six competencies which represent areas of skill and knowledge that residents are expected to demonstrate before graduation. These six core competencies (a) Professionalism (b) Patient Care (c) Medical knowledge (d) Practice based learning and improvement (e) Interpersonal and communication skills (f) System based practice must be kept in mind while preparing the curriculum and planning teaching and learning methods to provide the needed focus and direction (23).

Competency-based medical education differs from the subject-centered and the integrated course in three main ways a) a curriculum is organized around functions (or competencies) required for the practice of medicine in a specific setting b) it is formulated on the empirically validated principle so that students of the intellectual quality found in medical school, when given appropriate instruction, can master the prescribed basic performance objectives and c) it views education as an experiment where both student learning and the techniques used to produce learning are regarded as hypotheses subject to learning (24).

In competency based education, learning goals are explicitly stated, defined in advance and linked with competencies. The learning opportunities should be based on real-life clinical situations/problems. The experienced faculty would provide an objective basis for the self-assessment of the learner by using appropriate questions, assignments, feedback, etc to address the problem. Discussion with experienced faculty would also provide the appropriate standard for the learner to self assess and improve. It is to be remembered that all resident learners would be not of the same standard in abilities, motivation and knowledge and additional resources/ attention may be given to those who are at a disadvantage.

Community-oriented and Community-based Medical Education

Community-based and Community-oriented medical education is the topical area of interest in the current discussions about medical education. Though the

distinction between community-oriented and community-based education is not very clear, community-based education is closely related to but not the same as community-oriented education (25).

Community-orientation in Medical Education (COME) is an educational process, which focuses on population groups and individual persons in the community, and takes into consideration the health needs of the community concerned. The characteristics of COME shall be based on the objectives and the content of the curriculum of the particular institution and its relevance to health needs of the community within which the particular institution is located, rather than a mainly curative approach to health promotion. A community-oriented curriculum should also encompass health promotion, illness prevention, assessment and targeting of population needs and awareness of environmental and social factors in disease.

Whereas, Community-based education is a means of achieving educational relevance to community needs and consequently enables implementation of a community-oriented educational program. It consists of learning activities that use the community setting extensively as a learning environment, in which not only students but also teachers, members of the community and representatives of other sectors are actively engaged throughout the educational experience. Its aim is to produce community-oriented doctors who are able and willing to serve their communities and deal effectively with health problems at primary and secondary hospitals. It is now recognized as an important additional tool available in medical education to train skilled doctors needed in the primary and secondary hospitals more than in the tertiary hospitals. It is widely accepted that community setting provides a wealth of opportunities for students and trainees by exposing themselves to practice in situations out side the classroom or a teaching hospital and can help addressing some of the problems that confront them in the hospital settings. In addition, it gives students an opportunity to learn about the health needs and demands of the people that they serve later and the rural training sites are appropriate for them to learn about the range of social, political and economic forces that affect the health of the society (25, 26).

According to the WHO Study Group, the following six reasons are in favor of community-based education (25).

It gives the students a sense of social responsibility by enabling them to obtain clear understanding of local community needs and the problems.

- It enables the students to relate theoretical knowledge to practical training.
- It helps to break down barriers between trained professionals and the lay public and to establish closer communication between campus and community they serve.
- It helps to keep the educational process up-to-date by continuously confronting the students with reality.
- It helps the students to acquire competency in areas relevant to community health needs utilizing the only available health service facilities.
- It is a powerful means of improving the quality of the community health services.

Continuing Professional Development (CPD)

Medical education requires continuous updating of knowledge and skills by the medical professionals, whether a medical teacher, a consultant or the practitioner from his student days to till the day he stops practicing. This involves a life long process of learning. Continuing professional development (CPD) or continuing professional education (CPE) is the means by which members of professional associations maintain, improve and broaden their knowledge and skills and develop the personal qualities required in their professional lives to remedy practice gaps and to enable them to respond to the challenges of ever changing professional environment. It should be planned to the needs of the medical professional based on both self-assessment and peer-review. It can be achieved through continuous education and training, the period of which commences after completion of basic medical education and postgraduate training, thereafter extending throughout their professional practice.

In this direction, medical educators have to create a mechanism that encourages personal responsibility for maintaining competencies and assure the society of its fulfillment. It also should be ensured that the competencies learned through CPD programs by the new graduates are maintained and gaps in knowledge are removed so that the doctors are fully prepared to face challenges that confront them in discharge of his duties. The role of mandatory traditional

CME programs in maintaining the competence is questionable. They should include group-based activities and use quality improvement parameters. Eight principles have been suggested by various authors, (27, 28).

(a) CME planning and program development be based on needs assessment including outcome data

(b) Goal should include development of skills needed for life long learning, exercise of clinical reasoning, an understanding of decision making process and specific content acquisition

(c) Goals should be reinforced by appropriate choice of learning methods,

(d) New instructional techniques for CME should be based on their intrinsic strengths as learning tools after thorough evaluation,

e) Faculty development is important and should include exposure to new learning methods,

f) Educational activities should be supportive of and coordinated with transition to evidence-based medicine,

g) Professional and interdisciplinary interaction (if possible) should be given priority,

h) Outcome based measure of CME effectiveness and research should be introduced into the determinants of physicians practice behavior.

Such Faculty Development Programs providing teachers with the capabilities necessary to improve their teaching skills are an effective method in sensitizing medical professionals to the concepts involved in teaching and help them to develop necessary knowledge and clinical skills to make them competent and effective teachers, administrators, researchers and mentors. The newly recruited faculty should also be given training in research methodologies and assessment strategies so that he is able to conduct research projects and deliver health care in a secondary or tertiary hospital. Recognizing the need for better equipping the medical teachers with core competencies in clinical assessment skills, laboratory methodologies, interpretation skills, assessment strategies and communication abilities, Medical Council of India (by the MCI Regulations on Graduate Medical Education, 1997 (9), stated that the establishment of Medical Education Units is mandatory in all medical colleges, to ensure continuous

professional development.

Conclusion

The changing trends in medical Education essentially fall under three categories; a) Teaching, b) Training and c) Application of the skills to improve the health of the community. The need to improve medical education in the country cannot be overemphasized and should be accompanied by regular curricular reforms which should be based on the health problems of the community and its health needs. The curriculum should move away from teacher-centered to student-centered with emphasis on self-directed learning, adequate clinical contact, emphasis on ethical issues and exposure to new communication technologies. The undergraduate curriculum should be an integrated curriculum and system-based to avoid unnecessary duplication. Teaching is to be restricted to 'core curriculum' that is 'must know' and this is supplemented by 'desirable to know'. The training of the medical graduate through learned-centered education, problem based learning and competency based education with specially designed modules, enables him to attain additional knowledge that is 'desirable to know'. The teaching of basics in bioethics, molecular biology and information technology improves the scientific knowledge and communication skills of the medical graduate and increases his approach towards social responsibility. The teaching and learning methods should promote competency-based learning. However, the postgraduate curriculum in particular needs to be constantly revised and updated.

Further, application of evidence-based medicine and proficiency development through continuing medical education updates the skills and knowledge of medical professional including medical teachers. This will ensure their competency from time to time to tackle the medical problems that they face from the community they serve. The medical teachers have to keep pace with the changing trends and play a key role in implementation of changes to produce the quality end product of medical education. The teachers should undergo life-long learning by regular participation in continuing medical education program. It is just not enough if the curriculum is changed and teachers trained but also a change is needed in those who govern and participate in medical education.

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Retinopathy at High Altitude and other Ocular Changes

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ABSTRACT

Retinal haemorrhages in mountain climbers have been reported from time to time and their incidence has varied in different studies. The results are based on the observations made in small number of members taking part in expeditions. We studied this aspect as large number of troops were inducted in high altitude areas during sixties and seventies. Studies were carried out on 250 healthy soldiers in the age group 25-45 years, inducted to a Himalayan station located at an altitude of 11550 feet. They underwent fundus examination on dilated pupils and relevant ocular parameters like, visual acuity, colour vision, tonometry and ophthalmodynamometry were carried out. They were then dispatched to pickets at altitudes varying from 12000 to 16000 feet. Seventy personnel developing symptoms of high altitude pulmonary oedema (HAPO) underwent fundus examination that showed 15 cases (21.4%) with papilloedema, all had venous engorgement, and 40 cases (57.1%) showed flame shaped superficial haemorrhages around the disc and mid periphery of retina. Haemorrhages resolved fully in 4-6 weeks. Asymptomatic personnel underwent fundus examination at 3-4 month intervals and on deinduction. Thirty of them (16.6%) had superficial haemorrhages scattered in the background but they had no symptoms of any kind. Observations have been discussed in the light of other studies and literature has been reviewed.

Keywords : High altitude, hypoxia, mountain sickness, retinopathy.

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Introduction

The environmental factors having role in high altitude disorders are reduced barometric pressure causing reduction in partial pressure of oxygen (Hypoxia), severe cold, low humidity, strong winds and increased solar radiation. Systematic studies on high altitude problems started after induction of large numbers of troops in high altitude areas in India in late sixties and early seventies. First report of changes in retina by way of haemorrhages, now more holistically called retinopathy were by Singh *et al* in cases of acute mountain sickness (AMS) (1). In an earlier study by Menon, wherein he presented clinical data of 101 cases of HAPO there is no mention of any ocular changes (2) There have also been studies on various aspects of high altitude retinopathy on limited number of members of mountaineering expeditions in Himalayan and South American mountains (3-7). Following the induction of Indian troops in high altitude areas observations on retinopathy based on study of larger numbers have been made by Sharma (8), Goswami (9) and Gupta (10). The study being reported is on follow up of 250 army personnel who were operating at altitude varying from 12000 to 16000 feet.

Material and Methods

Two hundred and fifty soldiers in the age group 25-45 years were inducted by air/ road in a northern Himalayan station at an altitude of 11550 feet. They were examined within a week of their arrival for visual acuity, colour vision, field of vision and intraocular pressure (IOP). Fundoscopy and ophthalmo-dynamometry were also undertaken. Fundus examination was carried out on dilated pupils. After varying periods of stay (2-3 weeks) at this altitude, they were transported or marched to outposts by surface route. Those with any retinal pathology were not included in the study.

The soldiers who developed effects of high altitude by way of HAPO were examined for the above parameters but more particularly for retinal vascular changes. Others were examined either if they reported with any visual and other symptoms or otherwise after interval of 3-4 months for one and a half years.

Observations

1. Two hundred soldiers were inducted by air and fifty by road. Seventy soldiers (37.5%) of those inducted by air complained of light headedness, lack of sleep, mild breathlessness and episodes of blurred vision lasting upto 5

seconds. These were transient and disappeared in 3-4 days. Those inducted by road did not suffer from these transient effects.

2. Fundus examination of 70 cases of HAPO revealed:
   (a) Early papilloedema in 15 cases (21.4%) (Fig. 1).
   (b) Engorged veins in all cases (Fig. 2).
   (c) Superficial flame shaped retinal haemorrhages around disc and mid periphery were seen in 40 cases (57.1%). In 4 cases superficial haemorrhages were extensive becoming pre-retinal (Fig. 3-5).
   (d) One case was found to have a branch retinal vein occlusion involving supero–temporal branch (Fig. 6).
   (e) No case in this study had macular and vitreous haemorrhage,
3. With improvement in general condition, disc oedema, venous engorgement, and retinal haemorrhages recovered fully in 4-6 weeks.
4. Examination of the 180 asymptomatic personnel revealed that 30 (16.6%) had scattered flame shaped and splinter haemorrhages in various stages of absorption and some neovascularisation. These personnel had been operating at altitudes above 14000 feet for periods varying from 6 months to one year.

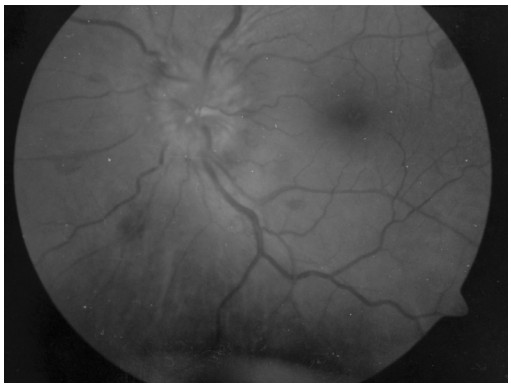

Fig. 1 : Fundus photograph showing papilloedema, haemorrhages and venous engorgement.

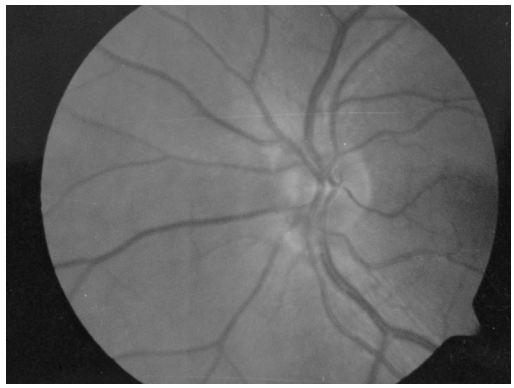

Fig. 2 : Fundus photograph showing dilatation of retinal vasculature

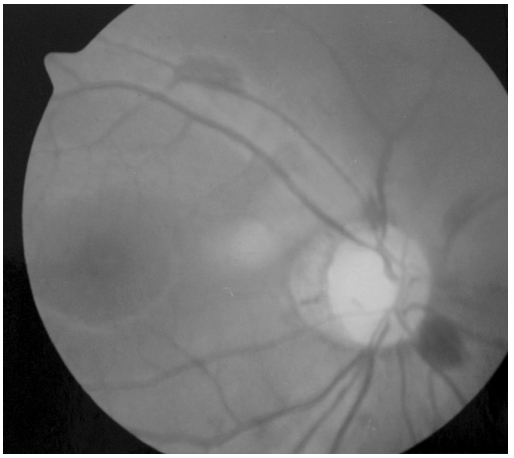

Fig. 3 : Fundus photograph showing peripapillary haemorrhages

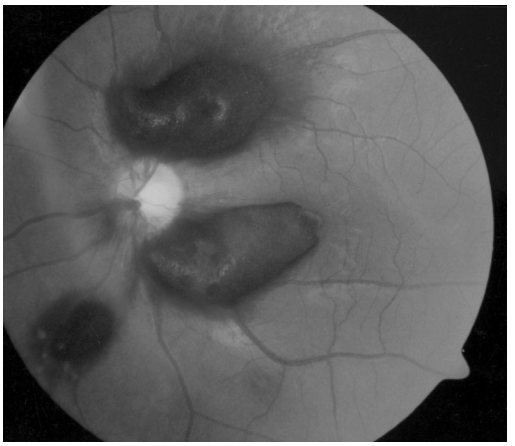

Fig. 5 : Fundus photograph showing extensive pre-retinal haemorrhages.

Fig. 4 : Fundus photograph showing scattered flame shaped haemorrhages in mid periphery

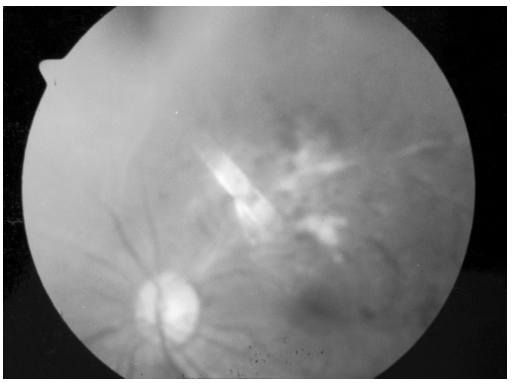

Fig. 6 : Fundus photograph showing branch retinal vein occlusion and neovascularisation.

5. IOP in all cases varied between 15-22 mm Hg by Schiotz tonometer on induction as well as on re-examination. However, 5 cases of glaucoma that were well controlled with 1-2% Pilocarpine drops went out of control and had to be evacuated to lower heights where the pressure got controlled on the same therapy.
6. No change in colour vision was recorded in any case.

7. Ophthalmodynamometry in non-symptomatic personnel showed the systolic pressure of central retinal artery between 60-100 mm Hg and diastolic between 35-60 mm Hg on initial as well as re-examination indicating rise in retinal arterial pressure.

Discussion

Transient effects of high altitude were found in those inducted by air. Those inducted by road did not have these effects indicating the beneficiary role of gradual climb and acclimatization. Similar observations have been made by Sharma and Goswami (8, 9).

The incidence of papilloedema (21.4%) in this study is much more than 1.2% reported by Singh et al.(1) It is possibly due to the fact that they had reported their findings in cases of AMS only. Their cases had not gone to the stage of HAPO but our observations are in cases of HAPO. Frayser et al also noticed pepilloedema in cases who were more severely affected than others (3).

Incidence of retinal haemorrhages of 57.1% in this study is fairly high. The incidence in various studies has varied from 1.3% to 66%. Singh et al 1.3% (24 cases out of 1925) (1) , Frayser et al 36% (9 cases out of 25)(3), Mc Fadden et al 56% amongst 39 climbers(6) and Shults and Swan 66% (4 out of 6 survivors of the ill fated Aconcagua expedition)(5). In a later study, Butler et al in their 14 Everest climbers found the incidence to be 29% which is on the lower side(7). Climbers in their study had followed a regime of gradual ascent with rest stops. This highlights the role of acclimatization in bringing down the incidence of retinopathy and other effects of high altitude. Another possible reason for these variations could be the varying parameters of climb and divergent conditions of ascent and exercise levels in different studies.

Pathophysiology of retinopathy is difficult to explain on any one single factor and is possibly multifactorial. Ocular and systemic blood pressures increase in high altitude sickness (11). Ophthalmodynamometry readings in our study have also shown rise in retinal arterial pressures. Hypobaric hypoxia results in reduction of partial pressure of oxygen from normal 95 mm Hg at sea level to approximately 60 mm Hg at 16000 feet. Drop in oxygen available to meet the body's metabolic requirements sets in motion a number of physiological processes such as increased cardiac output and minute ventilation. Frayser et al have shown that retinal blood flow increases producing clinically observable changes

of increase in diameter and tortuosity of retinal vasculature (4). Capillary fragility has also been shown to increase (12). All these factors put together set the stage for retinopathy to take place. Additionally increased CSF pressure, causing effusion of CSF into the optic nerve sheath results in compression of retinal veins and papilloedema. Valsalva maneuver required during climbing and haematocrit changes may be further aiding development of retinopathy. Individual susceptibility may also be a factor.

IOP in our study does not seem to vary much at altitude. Subsequent study by Gupta shows the same (10). However, study by Sharma has shown a slight fall in IOP (8). Destabilization of glaucoma cases under treatment shows that possibly aqueous outflow might be getting compromised. Variations in corneal thickness due to cold and solar radiation may have some role also. More studies are required on this aspect.

Conclusions

Retinopathy is a definite accompaniment of changes induced by hypoxia and reduced barometric pressure at high altitude and is a reversible condition. Pathophysiology of retinopathy is multifactorial. Incidence is variable and has been coming down with acclimatization.

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