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YOGA AND MEDICAL SCIENCES

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The ultimate aim of medical sciences is the attainment of optimum physical and mental health for the individual. The ultimate aim of yogic practices is also the same, viz. physical and mental well-being. The difference, however, lies in the use of different methodologies and modalities to achieve those ends. During recent years there has been world-wide interest in yoga. Scientists have been much interested in finding out what actually results from the practice of yoga and in discovering a meeting ground on points of mutual interest, so that medicine and yoga together can achieve optimum functioning of not only the body but also of the mind.

Medical science tries to achieve optimum physical and mental health of the individual through preventive, curative and promotive means. However, for a long time medical professionals have laid much more emphasis on the curative aspect, and only relatively recently the preventive aspect is also being stressed. But the promotive aspect has so far not been given its due importance. On the other hand, in yogic practices the stress is mainly on the promotive aspects although some yogic methods are prescribed for curative purpose also.

Many scientific studies in our country and abroad have focussed on changes produced as a result of various types of yogic practices. The basis of yoga is direct incontrovertible experience since it claims to deal with the "inner world" or the mind, while science deals with the "outer world" which includes the body. The two being essentially complementary, their interrelationship is not easy to explore and often difficult to explain. A fundamental difficulty is lack of a mutually understandable scheme of concepts. The other important constraint is that the scientists can only find out what is going on in the body with the help of tools available to them. They thus try to interpret the effects of *yogabhayasa* and *yogakriyas* through such studies, rather than grasp all their consequences, including the subjective ones. Even such objective studies have demonstrated some positive effects of yoga. Such studies do not in any way minimise the subjective experiences of yogis, which we scientists are unfortunately not in a position to assess at the moment.

Although scientists feel least competent to interpret what yoga really stands for, what are the aims and objectives of yogic *kriyas* such as *asanas, pranayamas*, and *mudras*, and *yogabhayasa* such as meditation, and *samadhi*, it seems that the physical yogic practices mainly aim at achievement of positive bodily health, while meditative practices aim at influencing the mind and consciousness. In fact it is claimed by knowledgeable yogis that it is essential to first purify, ripen and vitalize the body through *asanas, pranayamas* and *mudras* before undertaking concentration, meditation and *samadhi*. As a result of yogic *asanas* and yogic discipline, it is possible for the human body to become a finely tuned instrument with a better capacity for development of mind and consciousness. Even the physical practices alone can make a very important contribution to physical fitness. Meditative practices, in addition, further improve bodily functions, including visceral functions, through influencing the mind.

There are thus three aspects of yoga : yoga and the body, yoga and the mind, and yoga and consciousness. Althogh these are three facets of the same integral human personality, it is advisable that the results obtained from various scientific investigations be categorized under these three headings.

The linkage between the mind and the body is now increasingly appreciated and there are certain yogic techniques which can help a great deal in utilising and developing these linkages for improving homeostatic conditions in the body. The influence of yogic meditation on states of consciousness is probably the most fascinating of all. Dr. Karan Singh, during his tenure as Health Minister, while inaugurating a seminar on yoga, had this to say about human consciousness: "The human race has evolved on this planet over many millions of years. Some people are always looking for miracles, but it seems to me that there is no greater miracle than the evaluation of human consciousness itself from the primeval and primordial soup that existed billions and billions of years ago when matter was totally inchoate. The way in which, from the earliest beginnings, matter and life on this planet have evolved culminating for the time being at least in human consciousness, is really the greatest continuing miracle that one could ever have imagined". There is a fascinating hypothesis being put forward by some that the next step in human evolution may not be a physical development but a development in consciousness.

Let us now examine the available evidence gathered by various scientific studies spread over the last few decades on the three aspects of yoga.

Yoga and the body

Several investigations describing the effects of *asanas* (yogic postures), *pranayamas* (breathing exercises), *bandhas* and other yogic *kriyas* have been appearing from time to time from different yoga centres in the country. In spite of limitations of proper equipment and requisite training of the investigators the information from these investigations provided the necessary impetus for reseach to quite a few professional scientists, who have since undertaken such studies. These studies have provided sufficient positive evidence on the beneficial results of such yogic exercises on the functioning of the muscular system, respiratory system, cardio-vascular system, and gastro-intestinal system. In addition to the improvement in their physical efficiency they have a tendency towards a more relaxed mental state. Such a toning effect on the mind is the major argument of yoga enthusiasts for preferring yogic exercise to other forms of physical exercise.

Some practitioners of *hatha yoga* tend to develop their physical and muscular powers for performing certain extreme forms of physical feats. There have even been reports of some *hatha* yogis being capable of stopping the heart as certified by some medical practitioners and even confirmed by two foreign scientists (1, 2). However, these reports have not been confirmed by further scientific scrutiny, at least on some *hatha* yogis claiming to perform such feats. These later investigations indicated that such practitioners develop the power of building up a high positive intrathoracic pressure by the use of thoracic muscles, thus almost cutting out the venous return to the heart with the result that due to a severe drop in cardiac output arterial pulse is not felt, and as heart valves do not close heart sounds are not audible with the stethoscope (3). However, X-ray screening shows an empty but continuously contracting heart. The yogis are able to maintain this state for a few seconds at a time.

Yoga and the mind

Sufficient scientific information is by now available to show that certain types of *yogabhyasa* result in improvement of various visceral functions of the body through their influence on the nervous system. Such results usually follow those yogic practices which have a meditative component.

The linkages between the mind and the body, widely accepted in the ancient wisdom, have now been scientifically well established. The role of limbic system of the brain in regulating the homeostatic conditions in the body by influencing the visceral mechanisms through the autonomic nervous outflow and endocrine secretions, is now well known. These central nervous regions are also involved in the affective (emotional) behaviour of the individual. Emotional or mental stress, by involving these mechanisms, upsets the optimum level of homeostasis. It can, therefore, be easily understood that by

properly "conditioning" these regions of the nervous system, normal homeostatic conditions can be maintained. The process of mental relaxation, through meditative practices, may thus be expected to produce such "conditioning".

Autonomic Balance. Quite a few scientific investigations carried out in India and abroad, on those practising certain forms of meditation, yogic or transcendental, have indicated that these practices result in an equilibrium in the functioning of the sympathetic and parasympathetic components of the autonomic nervous system. A battery of tests can provide an idea about autonomic balance, e.g. heart rate, blood pressure, respiratory rate, body temperature, skin resistance, metabolic rate, salivary secretion, gastro-intestinal motility and secretion, etc. Any kind of stress, physical or mental, if continued for prolonged periods, results in sympathetic dominance, as evidenced by gradual rise in blood pressure and heart rate, respiratory changes, increased metabolic activity, gastro-intestinal changes (even resulting ultimately in ulcers), endocrine disturbances, etc. Meditative practices gradually diminish sympathetic dominance, resulting in a better balance between the sympathetic and the parasympathertic.

It follows that results of *yogabhyas* have to be assessed very carefully. If an individual is in a state of sympathetic dominance to start with, he is likely to show pronounced effects of meditative practices. If, however, he starts with a well balanced autonomic equilibrium, the effects of meditation will be difficult to observe. This may also explian that meditative practices produce more pronounced effects in those cultures where perpetual stress and strain are responsible for sympathetic dominance. Some observations by clinicians claiming the beneficial effects of certain yogic practices in patients having hypertension, diabetes mellitus, gastro-intestinal disorders, epilepsy, etc. may also be easily explained along the same lines.

Voluntary Control of Autonomic Functions. It has been claimed that some *Raj* yogis, who have been meditating for prolonged periods (sometimes for years), develop the capacity to consciously and voluntarily control their visceral functions including the metabolic rate. By cutting down on their visceral and metabolic activity, they claim to live for long periods, needing only minimum amounts of energy for sustenance.

Physiologists generally believe that the neocortical regions (which consciously control the activities of somatic structures) cannot influence the functioning of limbic regions of the brain (which unconsciously influence visceral responses). Further, most physiological studies give an impression that it is possible to "condition" the neocortical areas but not the limbic mechanisms.

It has not been easy to scientifically substantiate the claims of *Raj* Yogis, since it is difficult to persuade them to agree to be investigated in a laboratory. However, in some rare studies, scientific evidence seems to corroborate such claims. Although, as stated earlier, complete voluntary stoppage of the heart was not observed in any practitioner, one yogi could voluntarily produce slowing of heart, confirmed by E.C.G. to be due to "complete heart-block", which lasted for about 15 seconds (4). Similarly, one yogi could voluntarily produce "localised' sweating and changes in skin temperature. Others could demonstrate variations in the motility of the involuntary musculature of the food pipe and the urinary tract. But the most remarkable evidence was provided by a yogi, whose metabolic activity was studied while he meditated in the sealed metal box. During meditation he could cut down his metabolic activity to about 40% below his expected basal metabolic rate (5).

Although these scientific observations are very few and far between, their significance lies in providing some 'positive' evidence of the possibility of developing voluntary control over visceral and metabolic activities. Further, these observations suggest that through yogabhyas not only one may be able to keep the body in good physical and mental health, through prolonged meditative practices the metabolic activity of the body may also be decreased, which in turn *may* promote longevity. The word 'may' has been used as there is no scientific evi-

dence available so far to demonstrate that it actually happens, although some yogis claim so.

Yoga and Consciousness

The question of consciousness has been exciting the interest of religious and learned men over centuries, and has now evoked tremendous interest in scientists also. All religious traditions provide descriptions of 'mystical consciousness'. *Raj* yogis claim that, by meditation, they can achieve the state of 'superconsciousness' or 'nirvana'. In spite of various investigations, scientific studies have so far failed to provide any correlation between activity of the brain and different states of 'consciousness'. This may be because electroencephalography (EEG) is the only important technique that has been used for determining changes in brain activity. Still, science has achieved whatever it has because of its capacity to formulate and examine hypotheses about phenomena which it cannot understand, and this applies to scientific studies on yogis also.

Das and Gastaut (6) were possibly the first to study EEG changes during meditation, and observed high voltage high frequency waves in early stages, and sleep-like changes in later stages. But their subjects were those who had practised meditation for short periods only. A large number of EEG investigations have since been undertaken by many workers during meditation. Although most of these report prominent and dominant alpha activity during meditation, there are some which have reported more variable EEG changes. As most of the subjects investigated are these who have practised yogic meditation for short periods in terms of weeks or months, such variable results can be expected.

However, some E.E.G. investigations carried out on very few yogis, who had been meditating for much longer periods, have provided very interesting results. During meditation they showed a prominent alpha activity, and this could not be desynchronised by exposing them to strong peripheral sensory inputs such as photic, auditory, thermal, noxious, etc. (7).

During different stages of sleep (semiconsciousness) or states of unconsciousness (anaesthetic or pathological), EEG activity is mostly of the slow wave type as reticular system is not being 'activated' through peripheral sensory inputs. Even during some states of sleep strong sensory inputs can lead to "arousal" or "alerting" type of brain responses.

Alpha activity is seen when the brain is conscious (awake), but is not exposed to strong peripheral stimuli, or involved in serious thinking. In such a state, any exposure to peripheral sensory inputs or onset of thinking results in desynchronised fast EEG activity, as a result of altering of the brain through activation of reticular system. Thus, the above mentioned EEG observations on meditating yogis whose alpha activity is not desynchronised by perpheral sensations suggest that these inputs are not able to further activate the brain; possibly they are blocked at lower levels of neuraxis. One may hypothesise from these observations that such meditating yogis are in a state of 'consciousness', but oblivious to sensory inputs from the periphery. One may further speculate that the claims of some *Raj* yogis, who have been meditating for a life-time to achieve "super consciousness", may not entirely be a myth.

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