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DR. S.V. APTE

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India

FUNCTIONAL SIGNIFICANCE OF GROWTH RETARDATION DUE TO MALNUTRITION

Protein calorie malnutrition (PCM) in young growing children is one of the most widespread nutritional problems in many developing countries, today. In India, 2 to 3% of preschool children belonging to poor communities suffer from the severe forms of the disease like kwashiorkor and marasmus, while 60 to 70% suffer from the mild and moderate forms which manifest themselves as varying degrees of growth retardation¹. Marginal forms of PCM, which are diagnosed by anthropometry, thus, appear to be a far more serious problem from the public health point of view.

Measurement of weight and height has been most commonly employed for assessing the growth status of children. The interpretation of anthropometric measurements requires the use of standards. There is considerable debate whether local or international standards are more appropriate. To evaluate the development of a given child, it is essential to have standards which can be accepted to reflect normal growth. Standards established on children in Western countries have been widely used for this purpose. While the use of such a reference standard may facilitate inter-regional and international comparisons, it is obviously essential to work out normal standards for each community in order to decide the true deviation of a given group from the normal attainable by it in the light of the genetic potential.

GROWTH AND DEVELOPMENT OF INDIAN CHILDREN:

The Indian Council of Medical Research undertook a nationwide study to establish the

much needed reference standard of growth and development of Indian children, for the country as a whole, as well as for each of the States in the country².

The data, which was of a cross-sectional nature collected from different parts of the country revealed regional variations. Mean values for heights and weights of children belonging to different States were found to be significantly different from one another. Children from Punjab and Delhi were found to be taller and heavier than those from Southern States. Also, the mean values for heights and weights of children belonging to urban areas were generally higher than those of children from rural areas, throughout the period of growth. However, these differences were statistically not significant.

Heights and weights were found to be significantly influenced by the socio-economic status: the figures being much higher in both sexes in children belonging to the well to do communities, indicating that adequate nutrition and satisfactory standards of living enjoyed by this group were responsible for better growth.

Comparison of data from different countries has revealed that the average Indian child is shorter and lighter than its counterpart in USA and in Britain. As the Indian data are based on measurements of children belonging to the lower socio-economic groups, which form the majority of Indian communities, these values cannot be considered as representing standard values. It has, in the past, been suggested that there may be

racial differences in the genetic potential for growth. Studies were, therefore, undertaken to obtain data on growth and development of healthy, normal children in whom constraints imposed by malnutrition and infection do not operate.

A cross-sectional study was undertaken by the National Institute of Nutrition, Hyderabad on a large number of healthy children attending various public schools in different parts of the country³. These schools cater to the educational needs of the really well-to-do sections. The heights and weights of these children up to the age of 14 years were considerable higher than those of children belonging to low income groups and essentially similar to those seen in well-nourished American children. These data suggest, therefore, that the genetic potential for growth of Indian children is similar to that of children from Western countries. The growth retardation observed among many Indian children would, therefore, appear to be due to environmental factors, of which nutrition is an important one.

In addition to these cross-sectional studies, a study was carried out in a group of well-to-do boys of the Hyderabad Public School⁴. Increments in height and weight over a four year period were found comparable to those seen in American children. More than 85% of children either maintained the normal growth pattern or showed improvement in relation to the American percentile values. These data lend strong support to the earlier observation that, given a satisfactory environment, Indian children grow as well as those in developed countries.

ASSESSMENT OF MALNUTRITION IN A COMMUNITY:

A variety of anthropometric indices based on weight and height are currently in use to quantitate malnutrition in a community. Weight for age, height for age, weight for height, weight for height for age, and weight/height² have all been used as parameters of growth status. Of these, two indices, namely, weight for height and weight/height² have been shown to be age independent and are, therefore, useful where ages of children are not known with certainty.

The quantum of malnutrition in different communities is often compared, though different anthropometric indices are used to assess the extent of malnutrition. Such comparisons may not be valid, since the extent of malnutrition

computed by these various indices has now been shown to vary widely. In a study carried out at Hyderabad, assessment based on weight for age, indicated that almost all the children in the community were malnourished⁵, while assessment using weight for height as the criterion suggested that only 75% of the group were malnourished. It may, however, be pointed out that these criteria have been devised with different objectives in view. For example, the use of deficit in weight for age is primarily intended for assessing the magnitude of the problem in a general way, while the criteria based on both weight and height is meant, in addition, to identify the severity and duration of malnutrition.

Another important factor which significantly modifies the quantum of malnutrition is the fixation of levels that separate normals from the malnourished. These are often arbitrary and by shifting these levels even slightly, estimates can alter considerably. When 80% of the standard was used as the line of demarcation, the prevalence rates of malnutrition were found to be 5%, 83% and 27% respectively based on deficits in height for age, weight for age and weight for height and when 90% of the standard was used, the prevalence rates came down considerably. It is clear, therefore, that there is an urgent need to develop methods which can be employed for the assessment of the true extent of malnutrition in a community.

FUNCTIONAL SIGNIFICANCE OF GROWTH RETARDATION:

One of the rational methods of determining whether children showing growth retardation due to inadequate food intake are really malnourished is to determine whether they are in any way functionally handicapped. Since body size and function need not necessarily always run parallel, studies of the relationship between physical size and physiological functions may be expected to provide data on the meaning of various grades of growth retardation. Recently, such studies have been carried out at the National Institute of Nutrition. Two functions - intestinal absorption of nutrients and immunocompetence, were measured.

Growth standards of the ICMR, were used for classifying children into three groups based on deficit in weight for age. Using the 50th percentile of the ICMR, value as representing the standard weight for age, the observed weight was expressed as percentage of the standard weight. Apparently healthy

children who had weights equal to or more than 80% of the standard were considered as normal and those whose weights were between 60 and 80% of standard were classified as suffering from mild-moderate PCM. Children with weights below 60% of the standard were considered to be suffering from severe PCM. This group of children invariably had clinical signs - they were suffering from either kwashiorkor or marasmus.

INTESTINAL FUNCTION:

It is generally believed that undernourished children suffer from varying degrees of malabsorption and that this factor may be important in aggravating existing malnutrition. Intestinal function was, therefore, assessed by studying absorption of two specific nutrients - dietary fat and vitamin B₁₂ and a substance which measures non-specific absorption capacity - xylose. All children suffering from the two severe forms of PCM showed defective absorption - the extent of malabsorption showing considerable variation between individuals. However, in none of the children with mild-moderate PCM, was intestinal function impaired⁶. These observations are contrary to what has been believed so far and suggest that malabsorption may not be an important factor in aggravating PCM in children. The public health significance of this observation, relating as it does to the great majority of growth retarded children, is obvious.

IMMUNOCOMPETENCE:

The interaction between malnutrition and resistance to infection is well known. A number of clinical, epidemiological and laboratory studies have shown that severe malnutrition increases susceptibility to infection. The mechanism by which this occurs is also known. Since almost all studies in the human situation have been done in very severely malnourished children, studies were carried out to determine the immunocompetence of children suffering from various degrees of growth retardation. A number of parameters such as phagocytic function of leucocytes, cell mediated immune response, circulating levels of immunoglobulins, concentrations of secretory immunoglobulins and antibody response to specific bacterial antigens like typhoid, diphtheria and tetanus were studied⁷.

In severely malnourished children, all parameters except circulating levels of immunoglobulins were impaired. In mild-

moderate PCM, only the phagocytic function of leucocytes and the immune responses were impaired and these defects appeared at different planes of altered growth status. Phagocytic function was found to be impaired when the weight deficit was 20% or more of the standard, while the cell mediated immune response was altered only when the weight deficit was at least 30%. Antibody response following antigen administration was unimpaired in all mild-moderate PCM. Similarly, secretory IgA levels remained normal. These observations suggest that all immunological functions are not equally sensitive to altered nutritional status. They do, however, show that malnourished children whose weights are below 80% of the standard (ICMR) are likely to be at increased risk since they suffer from at least one functional defect which may result in lowered resistance to infection.

Based upon the poor antibody response to bacterial antigens seen in children suffering from kwashiorkor and marasmus, it has sometimes been suggested that national immunisation programmes may not have the desired effect in poor communities, unless coupled with nutrition programmes. However, the observations made here suggest that even under existing conditions, a great majority of children would respond satisfactorily to active immunization procedures - an observation of considerable public health importance.

As indicated earlier, estimates of malnutrition in a community vary widely depending upon the diagnostic criteria used. The main purpose of such estimates is not only to delineate the extent of the problem but also to suggest guidelines for action. If only anthropometric measurements are employed and 80% of the weight standard set up for well-to-do children is used as the diagnostic criterion, 75% of rural Indian children would be classified as malnourished and these children would, therefore, be considered as needing nutritional intervention. Not all these children, however, show incompetence with respect to either their intestinal absorptive function or their immune status. Only children who have weights below 80% of ICMR standard, which is equivalent to 60% of the standards for well-to-do children, show altered immunocompetence and may, therefore, be considered at risk. This classification may be considered more appropriate, since it is based upon a parameter reflecting functional status. Such children constitute about 10% of the total child population.

It must, however, be pointed out that in these studies only two functional aspects of growth retardation have been investigated. It is essential to obtain information on as many functions as possible to enable a proper appreciation of the physiological significance of growth failure.

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Heights & weights of well-nourished Indian School Children. No.18 page 24.

ABSTRACTS

Some Research Projects completed in 1975

PEDIATRICS

Blood lead levels in children with pica (1972-1975)

The aims and objectives of the scheme were to study the prevalence of high blood lead levels in children with a history of pica and to identify sources of abnormal lead exposure in these children.

Estimation of blood lead was carried out in groups of children with pica, those using *surma*, and those presenting with a variety of complaints, which could possibly be symptomatic of lead toxicity, such as encephalopathy, mental retardation and abdominal pain. Children and adults living in a locality contaminated with battery scrapings (found to have a high lead content) were checked for blood lead content. Blood lead estimation was also done on control groups of children and adults, presenting with none of the symptoms known to be associated with lead toxicity. Of the 199 control children, 5 or 2.5% were found to have blood lead values of 40 mcgms per 100 ml or above (a value indicative of increased lead absorption). Of 71 adults 4.0 or 5.63% had high blood lead values. A signi-

ficantly higher percentage of children in the following groups had high blood lead values: Children with pica 29 out of 175 or 16.6%; children with encephalopathy 8 out of 39 or 20.5%; children using *surma* 12 out of 83 or 14.4%; and adults and children living in Motia Khan area exposed to battery scraping 7 out of 11 or 63.7%.

Multiple articles of the environment tested included water from taps and other sources, fresh water and after storage in different containers, spices, soil, *surma* and *surma* rock, battery scrapings from the Motia Khan area, articles used in cosmetics such as *kajal* and *sindoor*, paints, whitewash, aluminium vessels, *kalai* or tinning material, petrol, kerosene, samples of pottery and other miscellaneous articles. A high concentration of lead was found only in *surma*, *surma* rock and battery scrapings. Water had lead levels well below those recommended as safe by the WHO (50 mcg/L). Higher levels were found only when it was stored exclusively in lead pipes. Taps with a connecting lead pipe in which water had stood overnight showed lead values well below the limit of 300 mcg/L, set by WHO for tap water stored in pipes for 16 hours. Almost all pottery samples were in the safe range of 2 ppm leachable lead or less as recommended by the Indian Standards Institute.

In conclusion, environmental check showed *surma* and battery scrapings to be the main articles with possible risk of environmental lead toxicity.

Dr. Seeta Sinclair
Associate Prof. of Pediatrics
All India Institute
of Medical Sciences
New Delhi.

Dr. N.K. Bhide
Prof. & Head of the
Deptt. of Pharmacology
All India Institute
of Medical Sciences
New Delhi.

Dr. N. Basu
Chemist
Department of Pharmacology
All India Institute
of Medical Sciences
New Delhi.

ICMR/WHO SEMINAR ON STREPTOCOCCAL INFECTIONS AND THEIR SEQUELAE-NEWER ASPECTS IN LABORATORY DIAGNOSIS & CONTROL (FEBRUARY 23-27, 1976)

A Seminar on Streptococcal Infections and their sequelae-newer aspects in laboratory diagnosis & control-was held in the Department of Microbiology, Christian Medical College & Hospital, Vellore from February 23-27, 1976. The faculty consisted of Dr. J. Rotta, WHO Consultant, Chief, WHO Streptococcal Laboratory Prague, Czechoslovakia and Dr. Grace Koshi, Prof. of Microbiology, Christian Medical College, Vellore. In addition to 16 participants from laboratories of Southern India, 5 guest observers attended the seminar. The seminar considered the bacteriological, serological and epidemiological aspects of group A streptococci, including the preservation of these organisms by Sand Dessication.

At the conclusion of the seminar it was felt that, in the not very distant past, there was little information on the prevalence of pathogenic streptococci and streptococcal diseases in the countries of the tropical and subtropical zones.

In recent years, however, there has been an increasing inflow of information, purporting that haemolytic streptococci are highly prevalent in these areas and the incidence of group A streptococcus infection is much higher

than was believed in the past. In fact, the carriership of beta haemolytic streptococci in the upper respiratory tract of the populations of tropical and subtropical areas of Asia is of the same order as found in the temperate zones.

There is sufficient data documenting that skin infections due to haemolytic streptococci represent a very important health problem in the tropical and subtropical areas. In addition, group A streptococci cause respiratory infections which are responsible for the considerable incidence of rheumatic fever and rheumatic heart disease. Acute glomerulonephritis in the tropics and subtropics, however, is much more frequently seen after group A streptococcal skin infection than after respiratory disease.

More information is urgently needed to elucidate the real significance of these findings. This can be done through adequate clinical, bacteriological, serological, epidemiological and histopathological investigations. Pilot studies should be carried out in centres where prerequisites can be established for such research and for the application of the results to practice.

SUMMARY OF LECTURES DELIVERED AT ICMR, NEW DELHI

FORTIFICATION OF COMMON SALT WITH IRON BY DR. B.S. NARASINHA RAO, DEPUTY DIRECTOR, NIN, HYDERABAD ON 20.2.1976.

Iron deficiency anaemia is one of the major public health problems of nutritional origin in India. Fortification of common salt

with iron has been considered a practical and an effective method of providing additional iron to the at risk population groups in India to combat this disease. An important technical problem in the fortification of salt with iron is the selection of a suitable iron source. Four iron sources were investigated as to

their suitability for fortifying salt: insoluble iron compounds, ferrous citrate, ferrous sulphate with stabilizing agents, and ferric orthophosphate with absorption promoters. Two important criteria used in selecting the iron source were stability of the fortified salt on storage under high humidity conditions and satisfactory bio-availability of iron from it, when given with a meal.

Insoluble iron salts:

Salt fortified with insoluble iron compounds like ferric orthophosphate, ferric pyrophosphate, and sodium iron pyrophosphate did not develop any colour even after prolonged storage. However, absorption of iron from these compounds was unacceptably low, particularly when ingested with food.

Ferrous citrate:

Absorption of iron from ferrous citrate was almost similar to that from ferrous sulphate, when given alone or with a meal. Its stability, however, when added to common salt was poor as it developed a yellow colour on mixing and storage.

Ferrous sulphate with stabilizing agents:

Since an ideal iron compound like ferrous sulphate develops colour readily when added to salt, the possibility of using stabilising agents to prevent colour change was studied. Of the several stabilising agents tested, only two were satisfactory. Salt fortified with ferrous sulphate (2500 ppm), sodium hexametaphosphate (2500 ppm) and sodium acid sulphate (155 ppm) remained without any colour for several months. However, availability of iron from this combination was poor as compared to ferrous sulphate. The other agent, orthophosphoric acid (2500 ppm) when added to salt along with ferrous sulphate (2500 ppm) also prevented colour change, even after several months of storage but absorption of iron from this mixture, although satisfactory initially, decreased considerably during storage.

Ferric phosphate and absorption promoters:

Four chemical agents viz: ascorbic acid, cystine, sodium citrate and sodium acid sulphate were tested for improving iron absorption from salt fortified with ferric orthophosphate. It was observed that only in the presence of sodium acid sulphate the fortified salt was stable and iron absorption

from FePO_4 improved significantly.

Salt was therefore, fortified with ferric phosphate (3500 ppm) and sodium acid sulphate (5000 ppm). This fortified salt was stable and bioavailability of iron from it was comparable to ferrous sulphate. It was found to be generally acceptable for cooking by families of different socio-economic backgrounds.

These studies indicate that salt can be successfully fortified with ferric orthophosphate and sodium acid sulphate. An intake of 15g fortified salt which is the average salt intake in India would provide 15 mg of additional iron per adult per day. Since 3-4% of this iron is absorbed, it would provide about half the daily requirement. Fortification of salt according to this formula on a commercial scale and trials to determine its effectiveness in improving iron nutritional status under actual field conditions are currently under study.

SOME ASPECTS OF BCG VACCINATION BY DR. RAJ NARAIN, FORMER PROJECT DIRECTOR, TUBERCULOSIS PREVENTION TRIAL, BANGALORE, ON 19TH MARCH, 1976.

A large scale BCG trial in the northern part of Chingleput District, has been carried out since 1968. Some 264,000 persons were given either 0.1 mg dose or 0.01 mg dose of BCG vaccine or an injection with a placebo. At the time of vaccination, the population was also tested with 5 IU of PPD-S and 10 units of PPD-B. This population was kept under constant supervision with frequent X-ray estimations and sputum cultures.

BCG is believed to benefit only persons in whom the size of reaction to tuberculin is 0-7 mm. Of the new cases, which developed during the first 4 years of follow up, 62 (less than 3%) were from among those with an initial size of reaction of 0-7 mm. Although this number is too small for arriving at any conclusions, it is evident that with 100% efficacy, BCG could have prevented only about 3% of the total cases in this population, over a period of 4 years. It will take some time before the preventive value of BCG in this population can be assessed with any degree of accuracy.

Some other important results of the study obtained so far were:

- i. BCG vaccination of tuberculosis patients, as compared with the placebo injected controls, did not appear to increase the mortality rate nor did it lead to a greater breakdown of existing lesions amongst the patients.
- ii. BCG vaccination rendered the tuberculin test almost useless. Even 4 years after vaccination, it was not possible to identify the newly infected in the group vaccinated with the weak dose, although it was easily done in the placebo-injected controls.
- iii. Post-vaccination allergy waned rapidly in the population under study and by the end of 2 1/2 years, the difference in the mean size of tuberculin allergy between the vaccinated (0.1 mg dose) and the placebo-injected controls was only 4 mm. Three months after vaccination this difference was 12 mm. The reason for and the significance of this waning is not known.

A method to calculate mortality due to tuberculosis in children of the age group 1-4 years was described. This was based upon the difference in total mortality rates for two

studies, one in rural areas and the other in Madras city. Children with 12 mm or larger size induration to the tuberculin test were regarded as infected cases. The method depends on the basic assumption that the difference in mortality for infected and non-infected children is entirely due to tuberculosis. It was estimated that about 16 per thousand of infected children in this age group died as a result of tuberculosis. Mortality due to tuberculosis in non-infected children was 0.17 per thousand per annum in a rural population and 0.94 per thousand in a part of Madras city. Of the total deaths, less than 5% in the rural population and about 46% in Madras city were due to tuberculosis. The reason for this difference in tuberculosis mortality rates between the city and the rural areas could be that the protected water supply and/or other public health measures reduced the total mortality in Madras city but at the same time mortality due to tuberculosis was not affected, in fact was relatively increased.

In absolute terms prevalence of tuberculosis and mortality due to it were also higher in the city of Madras.

ICMR NEWS

JAPANESE LEPROSY MISSION FOUNDATION, AGRA

The leprosy centre at Agra was established by the Japanese Leprosy Mission Foundation, in 1967, with the major objective of care of leprosy patients in the hospital and to undertake research on certain aspects of leprosy. During the last 10 years this institute has done commendable work in establishing an active centre for care of leprosy patients and of late it has undertaken certain research projects in sero-diagnosis of leprosy. It has also established three peripheral out-patients units so as to cover a larger number of leprosy patients. This centre is to be taken over by the Ministry of Health and Family Planning on the 31st of March, 1976. The Ministry plans to hand over the centre to the Indian Council of Medical Research with a view to its being developed as a centre for research, training and service.

A COURSE IN CLINICAL CHEMISTRY & INSTRUMENTATION FOR TSS FELLOWS

A course in Clinical Chemistry & Instrumentation was held at the National Institute of Nutrition, Hyderabad from March 1-10, 1976. Twelve fellows attended the course which consisted of lectures, demonstrations and practicals. Apart from the principles and use of biochemical instruments and techniques, emphasis was laid on the practical application of biochemical methods in modern medicine. The course included a visit to the clinical section of the Institute at the Osmania Medical College, Hyderabad.

COURSE IN HAEMATOLOGY:

A certificate course in Blood Banking Technology and Haematology for medical officers is being held by the Council at the Blood Group Reference Centre, Bombay and Postgraduate Institute of Medical Education and Research, Chandigarh for a period of twelve weeks from 16th February, 1976 to 14th May, 1976.



OBITUARY

The Council announces with deep regret the sad demise of Prof. Sujoy B. Roy, Head of the Department of Cardiology, All India Institute of Medical Sciences, New Delhi. Prof. Roy died in New Delhi after a short illness. He graduated from the Rangoon Medical College, Rangoon and after postgraduate studies in England and the United States joined the Institute in 1958. Prof. Roy was associated

with the ICMR for over 15 years and in addition to his studies on Rheumatic Fever collaborated with the defence services in an ICMR Project to study the problem of cardio-respiratory systems at high altitude. He was Honorary Cardiologist to the President of India and was awarded the Padma Bhushan in 1975.

COUNCIL'S TRAINING PROGRAMMES FOR 1976-77

(A) EXISTING ANNUAL TRAINING COURSES:

Nutrition & Endocrinology:

At the National Institute of Nutrition, Hyderabad.

- (1) Annual Certificate Course in Nutrition; (December 1, 1976 to February 28, 1977)
- (2) M.Sc. (Applied Nutrition) Course: (June 1, 1976 to February 28, 1977)
- (3) Annual Certificate Course in Human Nutrition for Teachers in Agricultural Universities: (August - October, 1976)
- (4) Annual Training Course in Endocrinological Techniques and their Application:

Reproductive Biology and Fertility Control:

At the Institute for Research in Reproduction, Bombay.

- (1) Annual Certificate Course in Reproductive Biology and Fertility Control: (November 1, 1976 to April 30, 1977)
- (2) Annual Training Course on Hormone Assays: (February 1, 1977 to March 31, 1977)
- (3) Annual Training Course in Endocrinology and Fertility Control: (October, 1976)
- (4) Annual Training Course in Cytology and Cytogenetics: (September, 1976)

Haematology:

At the Blood Group Reference Centre, Bombay.

Comprehensive programme in Blood Banking Technology and Basic Haematology: (For a period of 3 months from February 15, 1976)

Immunology:

At ICMR/WHO Research and Training Centre in Immunology, Department of Biochemistry, A.I.I.M.S., New Delhi.

*Annual Training Course in Immunology

Animal Technicians Training:

At the Laboratory Animals Information Service, National Institute of Nutrition, Hyderabad.

Ninth Annual Animal Technicians Training Course: (For a period of three months from September 1, 1976)

Biostatistics:

At the National Institute of Nutrition, Hyderabad.

*Third Training Course in Biostatistics for Statisticians and Medical Research Workers.

(B) NEW TRAINING COURSES DURING 1976-77:

Virology:

*At the Virus Research Centre, Poona. Diploma course in Virology.

Amoebiasis:

At the School of Tropical Medical, Calcutta.

Technician's Training Course in the field of Amoebiasis: (For a period of three months from April 1, 1976)

Occupational Health:

At the National Institute of Occupational Health, Ahmedabad.

(1) *Pneumoconiosis:

This course, meant for the medical practitioners to be organised in co-operation with Directorate of Mines Safety, Dhanbad.

(2) *Diploma in Occupational Health for the year 1976-77 under Gujarat University.

Pharmacology and Drug Trials:

At Dr. U.K. Sheth's Unit, Seth G.S. Medical College, Bombay.

(1) *A short-term course for four weeks' training.

(2) *A long-term course for twelve weeks' training.

(C) COURSES FOR TALENT SEARCH SCHEME FELLOWS:

Haematological Techniques:

*At the Department of Haematology, Post-

graduate Institute of Medical Education and Research, Chandigarh.

Biochemistry & Instrumentation:

At the National Institute of Nutrition, Hyderabad. March 1-10, 1976.

Cell-Biology and Cyto-Genetics:

At the Indian Institute of Science, Bangalore. April 12-21, 1976.

Principles & Methods in Medical Statistics:

*At the Tuberculosis Chemotherapy Centre, Madras.

Courses in Immunological Techniques:

*At the Department of Biochemistry, AIIMS, New Delhi.

*Dates to be announced later

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