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1996 - 1997

REGIONAL MEDICAL RESEARCH CENTRE

(INDIAN COUNCIL OF MEDICAL RESEARCH)

BHUBANESWAR - 751 023, ORISSA

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1. PARASITE IMMUNOLOGY

1.1. IMMUNOLOGICAL INVESTIGATIONS IN HUMAN FILARIASIS USING PURIFIED ANTIGENS

Staff members : Dr. M.K. Das
Mrs. M.S. Bal
Mr. N. Mandal
Mr. H.S. Naik

1.1.1. Detergent soluble fraction of *Setaria digitata:*

This Centre earlier reported (Annual Report 1995-96) an antigen isolated from *Setaria digitata* which exhibited high antibody reactivities in amicrofilaraemic groups (endemic normals or chronic patients) compared to asymptomatic microfilaraemic (AS) group (n=50 in each group). The antigen was shown to be localized in the sheath of *Wuchereria bancrofti* microfilariae. The difference in the prevalence of seropositive individuals between microfilaraemic (AS) and amicrofilaraemic groups (EN or CP) is highly significant.

Progress:

1. Hydrocele patients (n= 25) with circulating microfilariae (mf) have reduced antibody levels especially IgM compared to mf negative counterparts. The data suggest that microfilaraemia controls (decreases) reactivity to $DSSd_1$ even in symptomatic filariae patients.

2. It was found using rabbit hyperimmune antisera to $DSSd_1$ that there is little antigenic similarity between $DSSd_1$ and saline soluble extracts of *S.digitata.*

3. IgM and IgG levels were determined in 54 individuals of different age groups (0-4, 5-9, 10-15, 16-22 yr) of endemic normals. IgG levels in children (< 9 yr) and adults (16-22 yr) were not different. But a successive increase in IgM levels appeared to increase with age. Even by 5 yrs of age, 65% of samples had IgM antibodies.

4. The pattern of IgG subclass recognition to $DSSd_I$ in filarial sera was determined. It is of interest to note that recognition of IgG subclass is different in filarial groups. Endemic normals sera recognized primarily IgG_3 while chronic filarial sera recognized IgG_1. These two cytophilic subclasses are however suppressed in asymptomatic microfilaraemics where IgG_4 is the dominant subclass. The predominance of IgG_3 subclass in endemic normals is of considerable interest considering the protective role of this subclass in various parasite diseases onchocerciasis, malaria and trypanosomiasis. The cytophilic antibodies IgG_1 and IgG_3 have potential in clearing parasites from circulation *(in vivo)*.

DEC therapy caused increased IgG and IgM production to $DSSd_I$ in AS patients. Diethylcarbamazine treatment interestingly altered the expression of IgG subclass in microfilaraemic individuals. DEC therapy induced increased IgG_3 and IgG_1, accompanied by a reciprocal fall in IgG_4, in the treated subjects. In pre-DEC treated AS sera, IgG_4 was the dominant subclass.

5. $DSSd_I$ was characterized to be a glycoprotein (25 μg glucose equivalent per mg of proteins). Sodium periodate treatment was used to assess the relative importance of carbohydrate determinants in binding to filarial sera. Periodate oxidation resulted reduction only in IgG binding in AS group indicating that carbohydrate epitopes of $DSSd_I$ are preferentially recognized by AS sera. Antibodies in amicrofilaraemic EN and CP groups do not appear to bind carbohydrate epitopes of $DSSd_I$.

6. Immunogenicity of $DSSd_I$ was evaluated in Balb/C and CBA/N strains of mice. Preliminary studies indicate that the antigen elicited primary response to $DSSd_I$ followed by strong secondary response in Balb/C while CBA/N strain failed to produce the specific antibodies at any time (a strain deficient in producing antibodies to T-independent antigen).

1.1.2. Filarial allergen Sd30:

1. IgE level to Sd30 was evaluated in hydrocele patients, an important group in the endemic regions of Orissa. Antibody levels were compared in patients with and without microfilaraemia. Hydrocele group is being compared immunologically with persons having elephantiasis who are in general microfilariae negative.

2. The filarial allergen Sd30 earlier implicated to have protease activity revealed a single band in gelatin-substrate SDS-PAGE.

1.2. ANTIGENICITY OF FILARIAL ENZYMES IN ENDEMIC POPULATION

Staff members : Dr. M.K. Das
Mrs. M.S. Bal
Mr. H.S. Naik

Proteases:

1. Immunochemical characterization of antigens, especially those having biological functions (e.g. as enzymes) can provide information relevant to the survival of parasites. Proteases of parasites are an important group of enzymes which are actively involved in host-parasite interactions - in parasite nutrition, inactivation of host immune response and invasion of host tissues. Antibodies inhibitory to proteases were detected in animals immune to or infected with parasites. Antibody-mediated inhibition of protease activities may induce arrested growth of parasites and consequently benefit the host. Indeed, proteases have been shown to confer resistance to many diseases.

Studies initiated by us have described filarial proteases as allergen and immunodiagnostic antigen in filariasis. The effect of antibodies isolated from different groups of filarial sera was studied on the protease activities in *W.bancrofti* infective larvae (L_3) that initiates human infection, extract of *Setaria digitata* adult (AE) an immuno analogue of human parasite and a protease fraction (Sd30) purified from *Setaria*. IgG from CP was the most effective in inhibiting protease activities in all preparations. IgG from AS partially inhibited activities in *W.bancrofti* L_3 and AE but not in Sd30, indicating differences in antigenicity of the protease. IgG from EN and NEN sera was not inhibitory to the protease. These results suggest that neutralizing antibodies to filarial proteases were generated during natural course of human filariasis. The generation of inhibitory antibodies depends on the severity of infection. Thus chronic patients with elephantiasis (and hydrocele) have highest level whereas endemic normals, a group exposed to infection but non-infected, have undetectable level of these antibodies. Sera from asymptomatic microfilaraemic individuals, another infected group in filariasis, showed intermediate degree of inhibition.

2. Filarial protease activities were analyzed by gelatin-substrate-gel electrophoresis which revealed the presence of multiple protease molecules in infective-larvae (L_3) of *B.malayi and W.bancrofti*. The purified protease SdP_1 from *Setaria* revealed a single band (110 KDa mol. wt.) in the substrate-gel. The inhibition by filarial antibodies was also reflected in the substrate-gel analysis.

3. A purified metal-dependent protease with high molecular wt (110 KDa) SdP_1 exhibited preferentially IgG_4 antibodies in filarial sera. At present there are few antigens available that are capable of inducing IgG_4 response selectively and SdP_1 might belong to this group. IgG_4 seropositivity as a marker of infection is determined in filarial sera. SdP_1 also exhibited appreciable IgE levels which correlate with IgG_4.

Glutathione-S-transferase (GST):

1. Antibody (IgG and IgM) levels to filarial GST were detected predominantly (90%) in *W.bancrofti* infected individuals compared with normal residents of endemic regions. However 50% of endemic normals were found to be IgM positive, though only 10% were IgG positive.

2. The effect of filarial serum on the enzymatic activity of GST was evaluated. Inhibition of GST activity was noticed with all categories of filarial sera which consists of both mf positive and mf negative individuals. Extent of inhibition was nearly equal among these groups, although more numbers of sera in CP and AS compared to EN exhibited the inhibition. DEC treatment of microfilaraemic carriers led to enhanced neutralizing effect of GST activity by the sera. The change in inhibition pattern was followed upto one year post treatment. Maximum increase in inhibition (about three times over the pretreatment) was observed by day 15, which gradually fell to the pre-treatment inhibition at five months after treatment.

1.3. IMMUNE RESPONSE TO PARASITIC LIPIDS IN HUMAN FILARIASIS

Staff members : Dr. M.K.Das
Dr. A.K.Satapathy
Mrs. M.S.Bal
Mr. H.S.Naik

Progress:

1. As reported earlier (Annual Report 1995-96) AS sera exhibited lowest levels of both IgG and IgM antibodies. But amicrofilaraemic sera of EN and CP groups in general have higher levels of antibodies. A significant correlation was noted between antibody levels to MF and adult lipids in all filarial sera.

2. Antibodies were found to be very low in sera collected from non-filarial areas such as Kalahandi (n=18) and Karanjia (n=19). The antibodies to lipidic fraction were also not detected in ten lepromatous sera (Central Jalma Inst. for Leprosy, Agra). These data suggest the filarial specificity of the antibodies. Periodate oxidation data indicate these antigens to be glycolipids.

3. I gG subclass typing revealed that asymptomatic microfilaraemic sera exhibited elevated IgG_2 and endemic normals exhibited IgG_1, IgG_2 response. Chronic filarial sera had IgG_3 and IgG_1. Interestingly IgG_4 response was negligible in AS as well as in other groups.

4. Age wise acquisition of glycolipid antibodies was investigated. However there was no significant difference in antibody levels between children (< 10 yrs) and adults. It was noted that IgG_2 is the major subclass in children in contrast to adults where besides IgG_2, IgG_1 is also prominent.

5. Antibody levels were measured in experimentally (*B.malayi* L_3) infected *Mastomys*. Animals without MF showed high antibody levels (3-fold higher) to glycolipid antigens than those animals with microfilaraemia. This result is in good agreement with the data found in humans.

6. Rabbit polyclonal antisera to glycolipids reacted marginally with $DSSd_1$ antigen suggesting limited cross-reaction between these antigens although their immunological properties (high antibody levels in amicrofilaraemic state) are similar in endemic individuals and both are located in parasite surface.

2. APPLIED IMMUNOLOGY

2.1. IMMUNOBIOLOGICAL STUDIES IN ACUTE BANCROFTIAN FILARIASIS

Staff members : Dr. B. Ravindran
Dr. B. K. Das
Mr. P. K. Sahoo

The origin and the processes involved in the onset of acute filarial episode ar not clearly understood. It is generally believed that immunological hyporesponsivenes associated with the amicrofilaraemic state is responsible for the absence of clinica symptoms in filariasis and that when that state is overcome the resulting immun response precipitates acute filarial disease. The possibility of secondary bacteri infections being responsible for acute disease has been proposed although it has no been demonstrated without ambiguity. The precise cause-effect relationship betwee immunological hyper-reactivity and acute filariasis is not currently known. The pathology observed in immunodeficient experimental animals infected with filaria parasites and lymphatic dilatation and cellular infiltration seen in asymptomatic parasite carriers have indicated that parasites themselves cause damage to the lymphatics. The investigations reported here address some of the issues associated with acute bancroftian filariasis.

The levels of tumour necrosis factor alpha (TNFα) was found to be significantly raised in circulation of patients with acute filariasis in comparison to those with chronic manifestations such as elephantiasis or hydrocele. There was a positive correlation between TNF levels and severity of acute disease as well as presence of fever as a symptom associated with the acute disease. These observations indicate the possible use of TNF inhibitors for clinical management of acute filariasis. The source of TNF in circulation was found to be from filarial parasites. All the developmental stages of bovine parasite *Setaria digitata* and human parasite *Brugia malayi* were found to synthesize and secrete molecules similar to mammalian TNF. The TNF activity in parasite extracts could be demonstrated by performing immunoassays using standard antibodies to murine as well as human TNF.

The biological activity of the parasite TNF could be demonstrated in a bioassay using L-929 cell line. The bioactivity could be neutralized by standard antibodies to TNF. The TNF activity in the E-S antigens (from adult stage parasites) could be

demonstrated in an *in vivo* assay using D-galactosamine primed mice. Immunohistochemical localisation of the parasite TNF using cut sections of adult stage parasites indicated that the molecule is present on the cuticle as well as on the surface of egg shell and intrauterine microfilariae. The possibility that the parasites may have absorbed host TNF resulting in TNF activity in parasite extracts was ruled out by demonstration of TNF message in parasites as shown by a northern blot using m-RNA prepared from adult stages of *Setaria digitata*.

2.2. IMMUNOLOGICAL COMPONENTS OF ANTI-DISEASE RESPONSE IN HUMAN AND EXPERIMENTAL MALARIA

Staff members : Dr.B.Ravindran
Dr.B.K.Das
Mr.P.K.Sahoo

Immunity to malaria in human communities develops only after a long period of exposure to the parasites. Anti-parasite immunity as indicated by elimination of parasites from the circulation develops much later than resistance to development of clinical manifestations. Thus it is not unusual to encounter individuals with circulating parasites and with no clinical manifestations particularly in holoendemic regions. The precise factors that govern anti-disease immunity are unclear. Most studies in the past have addressed only the issue of 'what constitutes anti-parasite immunity'. Studies were undertaken in cerebral and non-cerebral malaria cases to correlate prognosis with *in vivo* immunological correlates such as levels of autoantibodies and inflammatory cytokines such as tumour necrosis factor (TNF) and interferon gamma. The following is the summary of the findings of the current study.

There was an inverse correlation between the circulating TNF levels and titers of antibodies to phospholipids in both cerebral and non-complicated malaria cases. The higher titres of anti-phospholipid antibodies correlated with better prognosis in human cerebral malaria. There was a positive correlation between another auto antibody namely antibodies to alpha-galactose (anti-gal) and endemicity to *P.falciparum* malaria. Anti-gal was found to be significantly raised in normal individuals residing in high malaria endemic areas. The association was more pronounced when the titres were measured in circulating immune complexes than in sera.

Isotyping of anti-gal in various categories revealed a very significant increase of IgG_1 anti-gal in immune sera and in sera collected from non-complicated cases of

malaria. Such an increase was not observed in sera collected from cerebral malaria cases. IgG_1 appears to be the protective isotype of auto-antibodies in anti-disease immunity to malaria since we had earlier demonstrated a significant association between good prognosis in cerebral malaria and high level of IgG_1 anti-phospholipid antibodies.

Purified immunoglobulins from such high endemic sera were tested for their efficacy to neutralize *in vivo* the toxic malarial exo-antigen. *In vitro* released exo-antigens of *P.berghei* were found to mediate death of D-galactosamine primed mice-the reaction being mediated by induction of hypersensitivity to TNF induced by exo-antigens. Only purified Igs from high endemic areas and not those from low or non endemic areas were found to neutralize the toxicity mediated by malarial exo-antigens. Studies on the specificity of the neutralizing antibodies indicated that the activity was mediated by high titers of anti-gal present in hyperimmune sera indicating that anti-disease immunity is primarily mediated by auto-antibodies than antimalarial antibodies. Since there was a significant association between high levels of TNF and mortality in cerebral malaria the beneficial effect of a TNF inhibitor such as pentoxifylline is being evaluated along with quinine therapy in cerebral malaria.

2.3. IMMUNOLOGICAL STUDIES ON ANTIBODIES TO DEC - AN APPROACH TO DEVELOPING AN IMMUNOPROPHYLACTIC AGENT AGAINST FILARIAL PARASITES

Staff members : Dr.B.Ravindran
Ms.S.Mukhopadhyaya
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Ms.M. C.Mohanty

The antigenic mimicry observed between the antifilarial drug, Diethylcarbamazine (DEC) and a filarial antigen on the surface of microfilariae has been the basis of this approach. Antibodies to the hapten methyl piperazine carboxylic acid (MPCA) was found to react with the filarial antigen. Studies have been addressed to investigate if this cross reactivity can be utilised to develop an immunoprophylactic agent. Since the cross reacting antigen was found to be expressed in all the developing stages of the parasite, the efficacy of both polyclonal and monoclonal antibodies in eliminating the circulating MF and in inhibiting the developing larvae were studied using two animal models viz., *B.malayi* and *Setaria digitata* in *Mastomys coucha*. The following is the summary of the results.

Both polyclonal and monoclonal antibody to AgW recognized 2 components of 200 and 100 KDa (similar to recognition by WGA) in an SDS immunoblot of adult antigens of *Setaria digitata*. In a non SDS PAGE and Western Blot the antibody recognized only 200 KDa molecule indicating that in native form AgW exists as a single molecule of 200 KDa and that SDS partially dissociates the molecule. The antigen was found to be heat resistant but sensitive to Sodium meta-periodate treatment. The criss-cross reactivity between anti-AgW and anti-DEC (both raised in *Mastomys*) and simultaneous criss-cross inhibition in ELISA proves the fact that both anti-AgW and anti-DEC recognized the same epitope structure. Inhibition of reactivity of anti-AgW to parasite MF by DEC further corroborates this conclusion.

The monoclonal antibody (mAb) to AgW (designated as P1E3) was found to have a differential surface reactivity to different stages of filarial parasites, viz., it reacted very strongly with adult and L_3 stages of *Setaria digitata*, L_5 of *B.malayi*; marginally with L_4 of *B.malayi* and with no demonstrable reactivity to surface of *B.malayi* infective larvae (L_3). The mAb was also shown to have reactivity against soluble antigens prepared from *Setaria digitata* adults and *B.malayi* adults and *B.malayi* L_3. Immunohistochemistry with the adult worm of *Setaria digitata* revealed that P1E3 recognized molecules localized on cuticle, hypodermis, dermis and on MF and egg surface. The mAb reacted strongly with the hapten MPCA in an EIA and its reactivity to parasite MF in an immunoperoxidase assay could be inhibited by 10 mM concentration of DEC indicating the fact mAb to AgW cross react with the drug, DEC.

Epitope characterization indicated that P1E3 reacted with the sugar moiety N-acetyl-D-Glucosamine (GlcNAc) on AgW since i) reactivity of P1E3 in an EIA was inhibitable by GlcNAc; ii) P1E3 reacted with N-acetyl-D-Glucosamine-Bovine Serum albumin (GlcNAc-BSA) in an EIA with no reactivity to BSA and iii) the anti-sheath reactivity of P1E3 to MF of filarial parasites was inhibitable by GlcNAc. All these experiments prove strongly that filarial antigen AgW contains conserved carbohydrate epitope(s) in all the developmental stages of the filarial parasites and its expression on MF was responsible for the reactivity of anti-DEC to MF sheath. The mAb per se was found to be microfilaricidal in *Setaria digitata* infected *Mastomys coucha* as well as cytotoxic to developing larvae since an intraperitoneal weekly administration of the mAb decreased both the total yield and the length of the worms in *B.malayi* L_3 infected CBA/N indicating AgW as a potential vaccine candidate molecule in experimental filariasis.

Immune responses to AgW was monitored in an infected human population with different clinical spectra (endemic normals, asymptomatic carriers, and chronic filariasis cases) and also in experimental animal models. The studies demonstrate that there was an immune response to AgW in human filariasis which did not differ significantly between the groups in IgM antibodies to AgW while IgG titres were significantly higher in chronic cases compared to the other two groups. The relationship of anti-AgW titre with protective immunity in human filariasis is currently not clear. Reactivities of human sera to AgW was inhibitable by both AgW and MPCA-BSA indicating that anti-DEC antibodies in human sera reported by us earlier were actually antibodies to AgW cross reacting with the drug.

The anti-AgW titres were found to be significantly higher in amicrofilaraemic *Mastomys coucha* infected with *B.malayi* compared to microfilaraemic animals demonstrating an association between absence of MFwith the presence of higher anti-AgW titres in experimental animals. Furthermore, failure of jirds to make antibodies to AgW when immunized with this molecule in Complete Freund's Adjuvant (CFA) appears to indicate an association between immune response to AgW and susceptibility to experimental filarial infections. Potentiation of microfilaricidal activity of DEC by filarial antibody cross reacting with DEC was monitored by administration of monoclonal antibody to AgW (P1E3) in microfilaraemic model of *Setaria digitata* implanted *Mastomys coucha*. P1E3 was found to potentiate DEC mediated parasite clearance *in vivo*. Microfilaraemic animals administered with both P1E3 and DEC cleared MF more effectively than those receiving either P1E3 or DEC indicating that the mode of action of DEC is antibody dependent and antibody to GlcNAc moiety present on AgW potentiate DEC mediated parasite clearance *in vivo*.

2.4. STUDIES ON SERUM CYTOTOXIC FACTORS IN MALARIA

Staff members : Dr.B.Ravindran
Mr.P.K.Sahoo

Crisis form factors (CFF) in malarial sera have been defined as circulating molecules that mediate cytotoxicity to the intra-erythrocytic stage parasites of plasmodia. They induce crisis forms resulting in non-development of the parasite. This has been proposed as a primary mechanism of development of acquired immunity at least in some geographical areas. The merozoite inhibitory antibodies inhibit the reinvasion of merozoites while the CFF act on the developing intraerythrocytic stage parasites. The precise nature of CFF is largely unknown. It is proposed to be a mixture

of tumour necrosis factor-α, interferon-γ, lipid peroxidation products and a host of other unknown host components. Unlike antimalarial antibodies which show a high degree of species specificity CFF mediated *in vitro* cytotoxicity to other malarial parasites also. These observations prompted us to study the target specificity of CFF towards other parasites (such as microfilaria) in circulation.

A significant number of malarial sera (about 40%) collected from *P.falciparum* endemic areas mediated *in vitro* cytotoxicity to microfilariae and infective larvae of *Setaria digitata* and *W.bancrofti.* Sera collected from cerebral malaria cases were more cytotoxic than sera of non-complicated cases of malaria. None of the filarial sera collected from any of the clinical category (chronic disease, MF carriers etc.) mediated cytotoxicity to filarial parasites. The active component in cytotoxic sera were not found to be any of the following: TNF, Interferon-γ, small molecular weight food toxins, lipid peroxidation products, residual chloroquine or quinine. Absorption of immunoglobulins resulted in significant loss of cytotoxic activity and affinity purified Igs were found to mediate mf cytotoxicity.

Although the cytotoxic activity was found to be associated with immunoglobulins the activity was not mediated by anti-filarial antibodies in malarial serum. The possibility of catalytic antibodies mediating the observed cytotoxicity is currently being investigated. Sera collected from tuberculosis or SLE cases were not found to mediate MF cytotoxicity. Significant differences were observed between malarial sera collected from different geographical regions.

2.5. DEVELOPMENT OF A LABORATORY ANIMAL MODEL FOR *W.BANCROFTI*

Staff members : Dr.B.Ravindran
Mr.P.K.Sahoo
Ms.M.C.Mohanty

In the absence of any convenient laboratory animal model for *W.bancrofti* a sub-periodic strain of *B.malayi* adapted in cats, jirds and Mastomys is being widely used. Immunocompetent mice however do not support the growth of *B.malayi*. They very rapidly eliminate the infective larvae. We had demonstrated earlier that mice with XID mutation sustain the MF longer than normal mice. Investigations in our laboratory as indicated below reveal that mice with XID mutation support the growth and development of infective larvae of *B.malayi*. This model may be useful for studying

the protective effect of antibodies directed towards L_3 and may also be used for evaluating the efficacy of potential drugs that act on the developing larvae.

The following is the progress of work done so far:

The infective larvae of *B.malayi* (the adapted sub-periodic strain) developed into juvenile adult stage parasites in CBA/N strain of mice which have an X-linked immunodeficiency (XID mutation). This renders them immunologically deficient for response to T-independent antigens. The mutation also results in changes in the profile of various cytokines during immune response to a variety of antigens. The worm yield in the wild type strain CBA/J was very minimal indicating that the observed higher susceptibility to larval development was due to only the XID mutation.

The larval development upto juvenile adult stages was observed only upto 6 weeks post infection. There was a progressive elimination of the worms from the peritoneum and by 12-14 weeks only 1.02% of the worms were found to be viable. This mouse model appears to support the initial moulting and worm development and the adults stage parasites get eliminated presumably by development of acquired immunity. The model has been successfully used to monitor the *in vivo* larvicidal activity of the monoclonal antibody P1E3. It also appears to be a promising model for screening the larvicidal activity of newer antifilarial drugs. There was no significant difference between the susceptible CBA/N strain and resistant CBA/J mice in terms of antibody response to adult somatic antigens and larval (L_3 as well as L_4) surface antigens. It is proposed to use this model for development of juvenile adult stage parasites of *W.bancrofti.*

3. CLINICAL DIVISION

3.1. CLINICO-EPIDEMIOLOGICAL STUDY ON IODINE DEFICIENCY DISORDERS IN A DISTRICT OF WESTERN ORISSA

Staff members : Dr. S. S. S. Mohapatra
Dr. G. Bulliyya
Dr. G. J. J. Babu
Mr. S. C. Rout
Mr. K. Dhal

Starting date : September 1995 (ongoing)

The study commenced with a target of covering 30 clusters in Bargarh district. So far 9 clusters have been covered. The Primary School children numbering to 980 were subjected to clinical examination, anthropometry and goitre palpation.

Clinical Evaluation:

The total goitre rate (TGR) in three blocks of Bargarh district namely, Attabira, Bargarh and Paikamal are 4.56%, 12.45% and 24.28% respectively. The average TGR for the district is 11.3%. Except Attabira block which can not be termed as endemic for goitre being less than 5% (WHO/ICCIDD/UNICEF criteria), the other two blocks, namely Bargarh and Paikamal are highly endemic for goitre. The grade-I goitre were found in 102 children whereas the grade-II goitre was found in 9 children.

So far as Vitamin A deficiency is concerned, Bitot's spot was found in 3.4% of cases in children (33/980), Vitamin B complex deficiency in terms of angular stomatitis was found in 5% of children (49/980).

Biochemical Evaluation:

Anaemia: 598 filter paper blood samples were collected and haemoglobin was estimated by extracting the samples in Drabkins solution by cynomethaemoglobin method. About 88% of the children were found to be anaemic in different grades. Out of them, 20.5% are severe (<6 gm/dl), 28.9% are moderate (6.1-9 gm/dl) and 38.9% are mild anaemics (9-11 gm/dl). Only 11.9% were found to have normal haemoglobin level.

Urine samples: A total of 60 urine samples have been collected so far. The laboratory is set for estimation of urinary iodine excretion by procuring necessary equipment and chemicals. The process is standardized and samples are being processed.

Serum T_4 and TSH: Sixty-two (62) venous blood samples and 7 umbilical cord blood samples were collected for estimation of T_4 and TSH respectively. The processing of sample will begin as soon as necessary chemicals are procured.

Water samples: Thirty (30) water samples from 9 clusters were collected from the drinking water sources of the study population and are to be processed yet.

People's Perception:

A KAP study is conducted to know about people's perception of IDD by administering a pretested questionnaire. So far 71 individuals (male 48 and female 23) are covered. The literacy rate in males is 71% and in females it is 39%. It is observed that only 21% of males and 9% of females are aware of the goitre. None of the people surveyed had the knowledge about the cause of goitre. Out of 71, two said that it is caused by a defect in 'air', 12 said 'water', 3 said 'food', 48 said they have 'no idea' and 6 said it is due to 'cold'. Similarly, none had the knowledge that this condition can be prevented. Only 3 used iodized salt regularly because it is 'good' and crystal like. Another 3 used it occasionally. Majority of the surveyed families (91.5%) do not use iodized salt at all.

4. MICROBIOLOGY

4.1.1. STUDIES ON HIV/AIDS IN ORISSA

Staff members : **Dr. B. B. Pal**
Mr. H. K. Khuntia
Mr. S. K. Mohanty (project staff)
Mr. S. Murmu (project staff)

Starting Year : **1987 (ongoing)**

4.1.1. Surveillance activities:

The sero-surveillance for HIV infection was initiated in 1987 at this Centre. Surveillance activities are being financially supported by the National AIDS Control Organisation (NACO), New Delhi. Currently, surveillance work is limited to screening high risk groups on the request of Government agencies and judicial courts. Whenever any request is being made by the State Government, screening of foreigners or Indians belonging to different categories was carried out. A total of 92 sera were screened this year for the presence of HIV infection. These samples were drawn from drug users, blood donors, STD cases, foreigners and others (general) category. From these 92 samples, 3 samples were repeatedly ELISA positive as well as Western Blot positive. All the three positive samples were from men. One of them has heterosexual promiscuous history, one has history of drug abuse and another was a voluntary blood donor. Out of total 43 positive samples (cumulative), 16 were from Indians and 27 were from foreigners. These foreigners hailed from Thailand and Myanmar (Burma).

This year the cumulative seropositivity rate for Indians has increased upto 2.2/1000 (16 out of 7316 samples) from 1.8/1000 (13 out of 7244 samples) in the previous year. For the foreigners the seropositivity rate decreased to 156.1/1000 (27 out of 173 samples) in 1997 from 176.5/1000 (27 out of 153 samples) recorded in the previous year, since there were no positive samples among 20 foreigners screened this year. According to NACO, New Delhi (Workshop on Sero-Surveillance for HIV Infection for Eastern Region held at Calcutta, February 1997) the seropositivity rate since inception to January 1997 is 17/1000 sample screened for the entire country. Whereas it is 2.57/1000 for the state of Orissa. Though the seropositivity rate is low for Orissa

in comparison to national level, precautionary measures should be taken seriously by strengthening blood screening at blood bank level. IEC activities should be intensified in different risk groups which are prone to HIV infection. Research on sentinel surveillance in different sites including high risk groups can be encouraged to monitor the trend of HIV infection.

4.1.2. Sero-surveillance for HIV infection among drug abusers

At the request of a drug-counselling centre, Centre for Youth and Social Development (CYSD), SAHARA (supported by Ministry of Welfare, Govt. of India), Bhubaneswar, blood samples of volunteers undergoing rehabilitation in their centre were screened. These samples were received under codes which were collected from drug-addicts undergoing treatment for drug de-addiction. These coded sera were tested for the presence of HIV antibodies. A total of 43 serum samples were received during June 1996 to December 1996 from drug addicts of different types. Depending upon the types of drug use, oral drug users are highest in number (17 out of 43) followed by multi drug users (12) and inhalation types (11). About 10% are aged below 20 years; about 40% each are aged 21-30 and 31-40 years and remaining 10% are aged more than 40 years. Multi drug usage is more common in younger age group subjects. Only one sample is found positive for HIV infection from an alcoholic addict and the sero-positivity rate is 23.8/1000. As the sample size is very small, it is difficult to draw any inference about the prevalence pattern of HIV infection in this high risk group. It is alarming to note that the number of drug addicts are gradually increasing not only at national level but also at state level. Preventive measures should be taken up for control of HIV infection in the general population as a whole as well as specific efforts have to be made to control the spread of these unhealthy habits.

4.1.3. IEC programme on HIV/AIDS:

A wealth of technical information (Posters in Hindi, English & Oriya; video cassette in English & Hindi; audio cassette in Oriya) is available on HIV/AIDS at this Centre. This year two programmes were conducted. The details are given separately in Extension and Education Activities.

4.2. HOSPITAL BASED STUDY ON DIARRHOEAL DISORDERS

Staff members : **Dr.B.B.Pal**
Dr.M.Anuradha
Mr.H.K.Khuntia

Starting date : **August 1995 (ongoing)**

A hospital based study of acute diarrhoeal disorders was continued during the year under report. The main aim of this study is to identify and categorise the various groups of pathogenic bacteria causing acute gastroenteritis/diarrhoea, and to provide useful bacteriological and antibiogram information to hospital authorities. This study is carried out in three hospitals, viz., Capital Hospital and Municipal Hospital, Bhubaneswar and S.V.B.P. Institute of Paediatrics, Cuttack.

Samples were collected as rectal swabs in transport media and subcultured in different selective media. Significant colonies were picked up, tested biochemically and finally antisera test was done for confirmation. A total of 114 samples were tested. Majority of samples were from infants (62.3%) aged 0-1 year, about 23.7% were from pre-school children, aged 1-5 years.

Out of the 114 samples tested, 21 samples (18.4%) had single pathogen. A total of 6 (5.3%) were positive for *Vibrio*, 4 (3.5%) for *Salmonella*, 3 (2.6%) for *Shigella*, 4 (3.5%) for *Citrobacter*, 2 (1.8%) for *Aeromonas* and 2 (1.8%) for *Pseudomonas*. All the *Vibrio* isolates were *Vibrio cholerae* 01 *Ogawa*. The antibiogram of the isolates were communicated to the clinicians for better management of the patients. In general, all the pathogens were sensitive to ciprofloxacin, norfloxacin and gentamycin, and resistant to erythromycin and ampicillin.

The role of *Rota* virus, different strains of pathogenic *E.coli*, Protozoan parasites and other agents were not investigated in this study. This might be the cause for lower percentage of identifiable pathogens isolated from diarrhoea patients. These studies will be continued both at hospital level and also at the field level, as and when the region records higher incidence of diarrhoeal disorders.

5. MEDICAL ENTOMOLOGY AND PARASITOLOGY

5.1. DEVELOPMENT OF FILARIAL PARASITES IN *AEDES AEGYPTI* LIVERPOOL STRAIN

Staff members : **Dr.A.P.Dash**
Dr.N.Mahapatra
Mr.S.K.Parida

Starting date : **October 1991**

Production of L_3 stage microfilaria (MF) of *B.malayi* was taken up for experimental purposes meant for immunological studies. The multimammate animal *Mastomys coucha* was infected with *Brugia malayi* and the blood meal of these animals was offered to black eyed Liverpool strain *Ae.aegypti* in successive batches to nurture microfilaria from L_1 stage to L_3 stage in the vector mosquitoes. The microfilaria density in the infected mammals ranged from 25-300 per 10 μl of blood. A total of 9368 mosquitoes (32 batches) were fed with infected blood meal from these infected animals and 6448 infective larvae (L_3) were obtained. The maximum no. of L_3 were produced during July compared to other months. L_3 load per mosquito was found to be high (5.0) during September when MF density ranged from 220-250 per 10 μl of blood. The average L_3 load was found to be 3.35. L_3 production was found to be low when mosquitoes were fed on low MF count animals.

Aedes aegypti (black eyed) Liverpool strain were also fed on the *Mastomys* infected with *Setaria digitata*. Total 350 mosquitoes were fed and 36 L_3 were procured.

5.2. STUDIES ON MOSQUITOES OF ORISSA IN RELATION TO FILARIASIS AND MALARIA/MOSQUITO REGISTRY

Staff members : **Dr. A. P. Dash**
Dr. N. Mahapatra
Dr. R. K. Hazra
Mr. S. K. Parida
Mr. H. K. Tripathy

Starting date : **June 1992**

Mosquitoes were collected from different areas of Puri, Khurdha and Angul districts. The areas are Pipili, Khurdha (endemic for filariasis), Gambharimunda and

Madhapur (endemic for malaria). The species composition reveals presence of 18 species belonging to 5 genera. Among *Anopheles*, *An.subpictus* and *An.vagus* (10-34 PMHD) are dominant and among *Culicines*, *Cx.quinquefasciatus* was encountered with higher density (22-47 PMHD). *An.fluviatilis* is the important malaria vector found only in Gambharimunda while *An.culicifacies* and *An.annularis* known malaria vectors were encountered in all 4 areas surveyed. The density of *An.culicifacies* (7-8 PMHD) was higher than *An.annularis* (2-4 PMHD) in the two malaria endemic areas.

Feeding behaviour:

Blood meals of 70 mosquitoes belonging to 6 species were analysed by micro dot ELISA test. The anthropophilic index of *Cx.quinquefasciatus* was 93.5% and the zoophilic index was almost 100% in case of *Ma.annulifera*, *Ma.uniformis*, *An.aconitus*, *An.vagus*, and *Cx.vishnui* when the blood meals were tested from the cattleshed population.

5.3. FIELD EVALUATION OF *B.SPHAERICUS* AGAINST *CULEX QUINQUEFASCIATUS* IN ORISSA (WHO/TDR PROJECT)

Staff members : **Dr.A.P.Dash**
Dr.N.Mahapatra
Dr.R.K.Hazra
Mr.H.K.Tripathy

Starting date : **March, 1992**

The Orissa state has been an endemic home for lymphatic filariasis. Filariasis due to *Wuchereria bancrofti* accounts for 98% of the infection and is transmitted by the ubiquitous mosquito *Cx.quinquefasciatus*. Vector control continues to be an important tool in the prevention of the vector borne diseases. In view of the high cost and adverse effects of insecticides, alternate methods like biocides are now increasingly tried against mosquitoes. *B.sphaericus* has been shown to be highly insecticidal to *Culex* larvae. A particularly attractive feature of *B.sphaericus* is its potential to persist and recycle under certain field conditions. Appropriate formulations have shown significant residual activity against *Cx.quinquefasciatus* in highly polluted breeding habitats. A large scale field evaluation of *B.sphaericus* against transmission of bancroftian filariasis was initiated in April 1992 with TDR support in Orissa. Two localities viz., Khurdha (45,000 population) and Pipili complex (35,000 population)

were taken up for the study. Khurdha was selected as the experimental area and Pipili as the comparison area. Baseline data on households, breeding places, species composition, vector density, infection and infectivity rates, biting habit of the vector, MF rate, MF density and MFD 50 were collected in both the areas for one year.

Intervention started with *B.sphaericus* (5g/m^2) from April 1993. This was the fourth year of intervention. Double treatment strategy was followed as decided in WHO/TDR meeting held at Cameroon, West Africa in 1993. Mass treatment of breeding sites with biocide was done twice a year i.e., in May (Pre-Monsoon) and in October (Post-monsoon). The first application of the biocide in 1993 drastically reduced the larval and adult densities by 90% and the infectivity rate was brought down to zero. Subsequently, however the efficacy of the biocide decreased and densities are now maintained at the 50% level of the baseline density.

The larval density in Khurdha (experimental area) varied between 10.5 to 23.8 per dip as compared to 22.0 to 46.5 in Pipili (comparison area). The adult density in Khurdha varied from 11.5 to 31.0 per man hour while the same varied from 30.7 to 65.6 per man hour in Pipili. The average man landing rate (per man per night) was 271 in Pipili, but it was 137 in Khurdha area. The mean infection and infectivity rates during the year were 2.0 and 0.6 respectively in Khurdha as compared to 4.9 and 1.75, respectively in Pipili.

The infectivity rate which was maintained at zero level till May in Khurdha increased to 0.6% in June, while it was 1.8% in Pipili. This project also measured the impact of the biocide on transmission indices like risk of infection index and annual transmission index, which were 0.11 and 1497 respectively in Khurdha as compared to 1.32 and 17,819 respectively in Pipili.

Exploratory analysis revealed some interesting patterns in the data. Mosquito density (PMHD) could be predicted with high accuracy based on environmental information. The same was true for biting rate and to a lesser extent for infectivity rate. There appears to be a critical threshold level of vector density in maintaining transmission of *W.bancrofti* in the experimental area of Orissa, India.

5.4. RISK FACTORS FOR PERSISTENCE MALARIA TRANSMISSION IN TWO GEOPHYSIOGRAPHICAL REGIONS OF ORISSA IN COMPARISON WITH BORDERING AREA

Staff members : **Dr.A.P.Dash**
Dr.N.Mahapatra
Mr.S.K.Parida
Dr.R.K.Hazra

Starting date : **July 1995**

Entomological and parasitological studies were initiated in two geophysiographical region of Orissa. Madhapur of Central table land and Banpur of coastal tract.

One hundred thirty seven (137) blood slides were collected and examined from Banapur, out of which 29 slides were positive for *Plasmodium falciparum* (Pf) and 5 were *P.vivax* (P.v.), Slide Positivity Rate (SPR) was 17.5% and Slide Falciparum Rate (SFR) was 13.9%. Three hundred seventeen (317) slides were collected and examined from Madhapur P.H.C., out of which 98 were positive for malaria, 96 slides were Pf and 2 were Pv. The SPR was 32.3 and SFR 31.1%. Nine species of Anophelines were collected. Among them the known vector species *An.fluviatilis*, *An.culicifacies*, *An.annulifera* were encountered in the survey.

5.5. EFFECT OF APHID EXTRACTS AND SOME INSECTICIDAL COMPOUNDS ON THE DEVELOPMENT OF MOSQUITOES

Staff members : **Dr.A.P.Dash**
Ms.R.Mohapatra

Starting date : **October 1992**

The acute toxicity of insecticides is used to produce mortality in target populations and sublethal dosages of insecticides may affect insect populations by: 1) affecting survival, 2) affecting the reproductive ability of individuals or 3) affecting the genetic make up of future generations. Some insecticides, particularly insect growth regulators (IGRs), in addition to inducing mortality in the subimaginal stages or the imago, can also induce morphogenetic aberrations of different categories. In our

laboratory studies, we have noted that mosquito larvae surviving sublethal treatment with different test compounds and subsequent stages resulting from the survivors suffer additional mortality (beyond 48h). This additional mortality was noted in the larval stage (treated) and the resulting pupae and adults which develop from the surviving larvae treated at sublethal concentrations.

Treatment of early 4th instar larvae with sublethal concentrations of natural JH, hexaflumuron, fenfluthrin, cyfluthrin and pyraclofos produced a variety of morphogenetic aberrations in the succeeding stages of the surviving larvae in *An.stephensi*, *Ae.aegypti* and *Cx.quinquefasciatus*. The abberations noted were many with gradations. In case of *An.stephensi* and *Ae.aegypti*, *pyraclofos* induced morphological anomalies like production of black larvae with elongated neck and branching at the last abdominal segment in 75% of the treated population. Treatment with hexaflumuron caused swollen headed curved larvae in 1/3rd of the population. *Cx. quinquefasciatus* did not show such abnormalities when treated with above compounds. The other 3 compounds did not produce such abnormalities in any of the species studied. Even if the abnormalities are noticed, they were seen in less than 10% of the population exposed.

6. CLINICAL PATHOLOGY

6.1. INVESTIGATIVE STUDY ON EPIDEMIC DEATHS IN KALAHANDI DISTRICT OF ORISSA

Staff members : Dr.G.P.Chhotray
Mr.Anil Kumar
Dr.K.Nagaraj
Mr.A.Mohapatra
Mr.N.S.Marai

Study period : February 1997

In view of the newspaper reports of the epidemic deaths/cases reported in Kalahandi district of Orissa during 1996, as well as due to assurance given to the Ministry by the Council with reference to a starred Parliament Question, a team from the RMRC, Bhubaneswar led by Dr. Chhotray visited the affected areas of Kalahandi district (Orissa) to assess the situation. The investigation was conducted from 31.01.97 to 04.02.97 and the findings were as follows:-

Kalahandi district is situated in the western part of Orissa having two distinct physiographic regions. (i) The plain lands covering about 59% of the total area of the district (ii) The hilly region covered with dense forest in the rest of the district. Out of the total population, the Scheduled Castes and Scheduled Tribes constituted 17% and 29% respectively.

The prospective and retrospective investigations revealed that sporadic outbreaks of gastroenteritis and other diarrhoeal disorders were being registered in a cyclic pattern in Kalahandi district of Orissa since 1993 as listed below.

Year	Attacks	Deaths
1993	1097	167
1994	195	29
1995	222	24
1996(30.10.96)	1100	187

It was observed that the sporadic outbreaks of diarrhoeal disorders affected the Kalahandi district during the early monsoon period from June 1996 and attained a peak during August-September and declined afterwards.

Nearly 70% of 187 deaths (134 deaths) occurred in adults aged 25 years or more and among these 134 deaths, senior citizens aged 60 years or more accounted for 38 deaths. About 69% of deaths (129 deaths) were reported from Thuamul Rampur (100 deaths) and Borda (29 deaths) blocks.

It was observed by the investigating team from RMRC, Bhubaneswar that local people were in the habit of using mainly spring water customarily for drinking and cooking purposes, although, tube wells exist. Analysis of water samples from sources other than tube wells did not reveal any *Vibrio cholerae* but were found to be unsuitable for drinking purposes.

The RMRC team carried out 32 verbal autopsy studies from among the 178 families that registered diarrhoea related deaths, including 3 alleged starvation deaths in Kalahandi district out of 5 listed cases.

The diarrhoeal disorders occurred during early monsoon period probably due to a lack of sanitary and hygienic awareness and local beliefs. Local health authorities could save many lives by delivering timely and appropriate medical care and advice. In remote areas the situation was aggravated by the inaccessibility of the areas.

The clinical manifestation as described by the relatives and other family members relate to loose motions (3-4 times) of acute onset, accompanied by vomiting (2-3 times) with mild fever. The course and progression of the disease were short and the death occurring between 24-72 hours after the onset of initial symptoms of the attack. Appropriate and timely treatment was given by medical/paramedical personnel in the form of ORS/IV fluid, antibiotics, etc. in the majority of cases (27/32).

In these families no evidence of any gross nutritional disorders was observed. There were no signs of severe forms of Protein Energy Malnutrition (PEM) in the vulnerable groups. Surviving family members of the deceased and concerned village population had normal nutritional profile. Considering the sporadic nature of the outbreak of diarrhoeal disorders and detailed clinical examination of the surviving family members performed by the investigating team, there was no tangible evidence

which could be attributed towards the possible starvational cause of death.

A cross-section survey was also carried out during July 1996 and January 1997 covering 765 children and 607 women in Kalahandi district. The survey confirmed satisfactory nutritional profile of these vulnerable groups and did not indicate any evidence of starvation conditions in Kalahandi district either in July 1996 or January 1997. These results are given in the Anthropometry and Nutrition Section.

Recommendations:

(1) It was observed that safe drinking water facilities (tube wells) are available in the villages studied. But health education measures need to be undertaken to convince the local communities to use tube wells for drinking purposes and to avoid usage of contaminated water and to seek timely treatment during illness.

(2) Detailed epidemiological and laboratory investigations should be carried out immediately when an epidemic is reported. This will facilitate proper identification of pathogens and source of infection, routes of spread, sensitivity of the organisms isolated for drugs and other measures to contain the outbreak in a short span of time. Disease surveillance system also needs to be strengthened to tackle such situations.

The local health authorities need to maintain close liaison and working arrangement for rapid epidemiological survey with institutes like NICD, Delhi (under DGHS); NICED, Calcutta and RMRC, Bhubaneswar.

6.2. STUDIES ON HEREDITARY HAEMATOLOGICAL DISORDERS

Staff members : Dr.G.P.Chhotray
Dr.J.J.Babu Geddam
Dr.M.R.Ranjit
Mr.B.N.Sethi
Mr.K.C.Dalai

Status : On going diagnostics.

During this period, a total number of 77 referred cases (male 40, female 37) from various coastal districts and central parts of Orissa were investigated by Clinical Pathology Division.

The patients presented with the main complaints of anaemia and weakness. Detailed clinical and laboratory investigations were performed. It was observed that 76.6% of total cases belonged to general castes (Brahmin, Karan, Khandayat and OBC), whereas 16.9% and 6.5% belonged to ST and SC groups respectively. Majority of the patients belonged to coastal tract of Orissa and rest of them belonged to central tableland. Further it could be observed that the patients belonged to all age groups beginning from 1 to 60 years. The median age being 27 for males and for females it was 15. There was a male preponderance observed in this referred sample studied by this Centre. While studying the haemoglobin phenotypes it was observed from the Hb electrophoresis pattern that 42.9% cases had a haemoglobin 'AA', followed by 29.8% sickle cell disease both homozygous (SS) and heterozygous (AS); sickle β^0 thal. could be diagnosed in 6.5% cases, β^+ in 2.6% cases and β^0 in 3.9% of cases. The diagnosis of thalassaemia could be established in 20.2% of cases, in which 64.7% cases were β thalassaemia minor, 5.9% cases had β^+, 11.8% with β thalassaemia and 17.6% having β thal. minor with high A_2.

Various clinical manifestations and peripheral blood picture of different groups of patients were summarised below. Out of total 77 cases studied, 57% had anaemia. The mean Hb% was 10.2 ± 2.9 gm/dl in males and 10.6 ± 1.9 gm/dl in females. The clinical examination revealed that 28.6% had splenomegaly and among these spleen was just palpable in about 45% cases, 1 cm enlarged in 27.2%, 2 cm enlarged in 13.6% and more than 3 cm enlarged in 27.2% cases respectively. Hepatomegaly was observed in 14.3% cases. Among these positive cases, liver was just palpable in 63.6% cases, 1 cm enlarged in 27.3% cases, and 2 cm enlarged in 9% cases respectively. The liver was non tender and firm in consistency. Jaundice could be noticed in 16.9% cases, out of which 30% cases had severe jaundice. The peripheral blood smear examination revealed microcytic hypochromic blood picture in 57.1% cases, and normocytic hypochromic picture in 41.6% cases. The premature cells of RBC series mainly normoblasts (0-10%) were observed in 37.1% of cases and more than 10% in 27.3% cases.

The higher haemoglobin 'F' levels were observed in $S\beta^+$, $S\beta^0$, β thal. minor, β thal$^+$ and β thal. cases. The Hb A_2 percentage was found to be high in thalassaemic cases.

Interesting observation

In three cases of thalassaemia revealing high A_2, a detailed history and clinical examination of the cases and the family pedigree was performed. The Hb electrophoresis in both acid and alkaline pH showed A_2 and admixed with other Hb types. Initially it was thought that it could be Hb E. but considering the clinical profile, red cell indices, electrophoresis pattern and red cell picture it was suspected that there could be a new Hb variant. So DNA extraction was performed and after testing the purity of the DNA samples, they were sent to IIH, Bombay for further confirmation at the molecular level, the results of which are awaited.

7. HUMAN GENETICS

7.1. DISTRIBUTION OF HAEMOGLOBINOPATHY, G6PD DEFICIENCY AND BLOOD GROUPS IN SOME SELECTED TRIBAL POPULATIONS OF ORISSA

Staff members : **Dr. R.S.Balgir**
Dr. B.P.Dash
Mr. B.Murmu
Mr. R.N.Nayak

Starting date : **April 1995**

OBJECTIVES:

(a) To study the distribution of abnormal haemoglobins, G6PD deficiency and some blood groups among the major tribal groups.
(b) To look for some rare and abnormal genetic characters of clinical importance.
(c) To suggest the best possible preventive and intervention measures.

During the previous year, 575 Ashram School children of Sundargarh district were screened for haemoglobinopathy, G6PD deficiency, ABO and Rh blood groups. As Mayurbhanj district of Orissa has the highest concentration of tribal population and the tribal populations are said to be highly vulnerable for these hereditary disorders, causing haemolytic anaemia, it was planned to carry out the study in Mayurbhanj district.

For the present study, a total of 273 children aged 6 to 15 years from three different Ashram Schools of Mayurabhanj district were screened for haemoglobinopathy, G6PD deficiency, ABO and Rh blood groups. The major tribal groups included in the study are Santal (n=94), Kolha (n=73), Bathudi (n=40) and Bhumiz (n=17). There were 49 students from other groups. About 2-3 ml of intravenous blood samples were collected from each student in to EDTA coated vials. Sickling test and blood groups typing were done in the field and the rest of the blood samples were transported under ice-cold conditions to the laboratory at RMRC, Bhubaneswar within 24 hours of collection and were analysed using standard procedures.

The sickle cell haemoglobinopathy was detected in trait (Hb AS) form in Santal (1.1%) and Bathudi (2.5%) tribals only. No case of sickle cell disorder was recorded in Kolha, Bhumiz and other mixed group. There were no homozygous sickle cell disease cases in these tribals. Beta-thalassaemia trait was detected in Santal (8.4%), Kolha (1.8%), and other mixed (2.0%) tribal students. However, it was not detected in Bathudi and Bhumiz tribes. The distribution of glucose-6-phosphate dehydrogenase (G6PD) deficiency is recorded among all tribals in Mayurbhanj district. The deficiency was recorded in Bhumiz (5.9%), Santal (8.5%), Kolha (9.8%) and Bathudi (12.5%) tribes. The deficiency was also recorded in Munda (1/3), Bhuyan (2/7) and Gond (2/3) tribals, but the sample size was small .

The distribution of ABO and Rhesus blood groups shows the preponderance of B blood group (36.2%) over O (29.5%) followed by A (25.4%) and AB (8.9%) and no case of Rhesus negative was detected among the tribals studied. This pattern is a characteristic feature of the tribal population of India. The present study shows this consistent trend.

Considering the different grades of anaemia among the Ashram School children, it has been observed that moderate (8.8%) to mild (52.4%) anaemia exists among the major tribes of Mayurbhanj district. There were 38.8% of the students who had normal haemoglobin level i.e. Hb >12.0 g/dl. The physical examination of the children was done for the signs and symptoms of nutritional deficiencies and any other hereditary abnormalities related with haemoglobinopathy by the local doctor who accompanied us in the field as per our request. The visible anaemia was recorded among 35.2% of the children examined. About 18% of the children showed spleen enlargement and 1.8% enlarged liver in this malaria endemic area.

Further studies in Mayurbhanj district of Orissa are in progress which will show definite pattern of disease prevalence.

1.2. REFERRAL SERVICES :

During the year under report, 16 cases were referred to us for clinical possibility of haemoglobinopathy. Families were studied in details to confirm the diagnosis. The diagnosis of the referred cases was as follows : Beta-thalassaemia major (4), sickle cell trait (6), homozygous sickle cell disease (1) and 5 subjects were normal. Genetic counselling was offered to these cases.

7.2. ANTHROPOMETRY AND NUTRITION SECTION

7.2.1. NUTRITIONAL PROFILE OF MOTHERS AND CHILDREN FROM KALAHANDI DISTRICT OF ORISSA

Staff members : Mr. Amarendra Mohapatra
Dr. J.J.B. Geddam
Mr. N.S. Marai
Mr. B. Murmu
Mrs. G. Mallick
Mr. A.S. Acharya
Dr. K. Satyanarayana

Study period : June 1996 to March 1997

A survey on the health and nutritional profile of mothers and children from Kalahandi district of Orissa was planned and carried out during the year under report Out of 195 Gram Panchayats (GPs), 15 GPs were selected by Population Proportiona to Size (PPS) basis by using WHO method of cluster sample selection. All the GPs were arranged region wise and the cumulative population was tabulated. This population total was divided by the number of clusters to obtain the sampling interval. The sampling interval was found to be 70,109 for this district to select 15 clusters. Using the random table, a random number was selected between 1 and 70,109, to obtain the placement of first cluster. This number was found to be 25,857. The GP which has cumulative total with this number was the first cluster selected for study. By adding the sampling interval 70,109 to the random number the second cluster was selected. The GP which had the cumulative population total 95,966 in its members was the second cluster selected for the study. Similarly, the remaining 13 clusters were selected by adding the sampling interval and finding out the GP having that particular number among its members. The selection of 15 clusters was completed in June 1996 itself. Seven clusters (GPs) were studied during July 1996 and 9 clusters were studied during January 1997. A minimum coverage of at least 20 children and 20 mothers in any given GP was the target. During the period between August 1996 and December 1996, there were reports in the press about epidemic of deaths in Kalahandi district attributed to various causes, including diarrhoeal disorders and starvation related syndrome.

A total of 607 mothers aged 15 to 45 years were studied from the 15 clusters. Similarly a total of 765 children aged below 5 years were studied from the 15 clusters.

The district administration was informed about the survey of nutritional status of families. The team requested different functionaries at the ground level to inform the families to participate in the survey. Anganwadi workers were assigned to help the team in bringing the children and mothers to the survey points in the selected villages. Most often, all reproductive age group women with their under 5 children were covered in this survey. The sample included beneficiaries of ICDS scheme also.

Anthropometry measurements like height, weight, mid-arm circumference and fat fold at triceps were measured using standard techniques and equipment. All the subjects were examined for clinical nutritional deficiency signs. Body weights of children were expressed as percentage of NCHS standards and classified according to Gomez classification. Children with less than 60% body weight for age were considered as Gomez Gr.III (severe under-nutrition). Children with 90% and above body weight status were considered as normally nourished. In rural Indian studies 8 to 10% of children were observed to have Gomez Gr.III under nutrition. Body Mass Index (BMI) of the mothers was computed from body weight in Kg and height in meters. Body weight was divided by squared value of height, expressed in meters (BMI = Wt. Kg ÷ Ht^2 mt.). Standard classification as adopted by NNMB was utilised. Women with BMI value below 16 were considered to represent chronic energy deficiency (CED) Gr.III. In rural Indian studies 10 to 12% women were observed in this under- nourished category i.e. CED Gr.III. Women with BMI values of 18.5 or more were taken as normally nourished.

Results on Mothers:

A total of 607 mothers were covered during the two parts of the study. It was observed that severe undernutrition among mothers from Kalahandi district was 7.2% of them, against 11.3% for rural india reported by the National Nutritional Monitoring Bureau (NNMB), Hyderabad. The prevalence of severe undernutrition in the second part of the study carried out during January 1997 was also found to be lower than rural Indian figure. Normal nutritional status with BMI 18.5 or more was seen in 49.1% of Kalahandi mothers which is equivalent to the figure of 50.7% in similar category in rural India data reported by the NNMB. Mothers who share most of the work in this society are expected to loose body weight and register a greater proportion of them with CED G.III if there is serious drought. Recording of less than 10% of mothers with CED Gr.III could be taken as a major pointer indicating satisfactory nutritional status of Kalahandi mothers.

A total of 607 mothers were covered for the assessment of clinical nutritional status. Vitamin-A deficiency, mostly Bitot's spots was observed in 58 mothers (9.5%). B-complex deficiency signs, mostly dominated by angular stomatitis was observed in 59 (9.7%) women. Among these, 7 women had cheilosis and/or glossitis also. A total of 21 (3.4%) women exhibited goitre of different degrees indicating the presence of Iodine Deficiency Disorders (IDDs) in this region. Five women had palpable goitre (Gr.I) and 16 women had Gr.II goitre.

Results on children:

A total of 765 children under 5 years of age were covered in Kalahandi district during the two parts of the survey. This includes 343 children surveyed during January 1997 soon after several reports appeared in the local and national papers regarding epidemic deaths attributed to several causes including starvation. The results of nutritional anthropometry and clinical nutritional status indicated satisfactory nutritional profile of Kalahandi children. This was true for the batch covered in July 1996 as well as that covered in January 1997. Severe undernutrition as measured by the proportion of children with less than 60% of referral body weight (Gomez Gr.III) was observed in 8 to 9% of children aged below 5 years. NNMB surveys also reported similar picture for rural India (8.7%). About 10% of 1 to 5 year children and 22% of 0 to 1 year old children registered normal nutritional status with 90% or more of referral body weight. This picture is again in conformity with rural Indian data reported by NNMB (9.9% normal status in 1 to 5 years children).

A total of 592 children aged 1 to 5 years have been covered for assessment of clinical nutritional status. Evidence of frank Protein Energy Malnutrition (PEM) in the form of Marasmus was seen in 4 children (0.7%). These children are aged about 2 years. A total of 26 (4.4%) children exhibited mild degree of PEM in the form of hair changes including dis-coloured hair, easily pluckable hair and sparse hair. Fourteen children (2.4%) had both discoloured hair and easily pluckable hair. Fifteen children (2.5%) were observed to have moon face and 2 (0.3%) children had shown evidence of emaciation. Pre-school children of Kalahandi registered frank signs of PEM in less than 1% of total and milder forms of PEM in less than 5% of total examined. These findings would indicate that the nutritional status of Kalahandi children is comparable to rural Indian picture as far as protein energy adequacy is concerned.

A total of 34 (5.7%) children exhibited B-complex deficiency signs - predominantly angular stomatitis. Vitamin-A deficiency signs were recorded in 7

(1.2%) children the predominant sign being Bitot's spot. Mottled enamel was recorded in 9 (1.5%) children. The overall nutritional status of Kalahandi children as assessed by clinical signs and symptoms is comparable to rural Indian picture.

The proportion of severe clinical forms of undernutrition as measured by the presence of Kwashiorkor and Marasmus was seen in 0.7% of pre-school children in this survey. The proportion of young children with severe deficient of body weight (Gomez Gr.III) was found to be similar to rural Indian average (about 9%), indicating a comparable nutritional profile between Kalahandi children and NNMB figures for rural children. Thus both by clinical parameters as well as by nutritional anthropometry indicators, Kalahandi children were observed to fare just like rural Indian children anywhere in the country. The batch of 343 children who were studied during the height of allegations of starvation deaths, also had similar nutritional profile. Absence of severe clinical forms of under nutrition beyond 1% and the presence of severe under nutrition as measured by nutritional anthropometry (Gomez Gr.III) in less than 10% children rules out the possibility of severe generalised drought conditions in this district in the preceding months. Recording of severe under nutrition (CED Gr.III) in less than 10% of mothers; recording of severe under nutrition in less than 10% of children (Gomez Gr.III) and recording of Kwashiorkor and Marasmus in less than 1% of children are obvious signs indicating that there is no severe drought and even if it is there, it is very well coped and/or managed by social/familial compensatory mechanisms. The objective medical data collected on women and children during January 1997 rules out the existence of severe drought and food scarcity conditions during preceeding months.

8. EPIDEMIOLOGY AND INFORMATICS

8.1. KALAHANDI CHILD SURVIVAL PROJECT

Staff members : Dr.K.Satyanarayana
Dr.K.Nagaraj
Dr.B.V.Babu
Mr.A.Mohapatra
Dr.J.J.B.Geddam
Mr.A.S.Acharya

The above staff members were involved in preparing the approach paper (conceptual framework) for planning of Kalahandi Child Survival Project (KCSP) on initiative for reduction of infant mortality rate. Dr.R.S.Balgir, AD and Dr.S.S.S.Mohapatra, AD were involved at some stages of preparation of this report. The available data from State government health authorities were analysed and available approaches were identified for health development and child survival. Among the total deliveries that have occurred in Kalahandi district during 1995-96, institutional deliveries and domiciliary deliveries constituted 9.4% and 90.6% respectively. In Nawapara district, the figures for institutional deliveries and domiciliary deliveries were 7.6% and 92.4% respectively. In Kalahandi district, in the year 1995-96, 77% of the domiciliary deliveries were conducted by trained personnel, as per state government health authorities. Domiciliary deliveries conducted by trained personnel in Nawapara district in 1995-96 constituted 63%. Incidence of low birth weight babies in Kalahandi and Nawapara districts during 1995-96 was observed to be 62.5% and 57% respectively. Immunization coverage in Kalahandi district for the year 1995-96 by Polio, BCG and DPT vaccines was observed to be 94.1%, 90.3% and 94.2% respectively. Measles immunization coverage was observed to be 83.2%. In Nawapara district, immunization coverage in the year 1995-96 by Polio, BCG and DPT vaccines was observed to be 86.5%, 95.0% and 86.4% respectively. Measles immunization coverage in Nawapara district was observed to be 82.0%.

Computation of infant mortality rate based on data from state government health authorities was found 122 per 1000 live births. National Family and Health Survey (NFHS) has shown that IMR in Orissa was 112 per 1000 live births (NFHS, 1995; IIPS, Bombay). Birth rate and death rate in Kalahandi were observed to be 21/1000 population and 8/1000 population respectively. Independent surveys by National Institute of Nutrition (NIN), Hyderabad have observed that about 90% of deliveries

are conducted by untrained personnel in Kalahandi district, (NIN Survey Report-1996). NFHS survey for the entire Orissa has indicated that traditional birth attendants have conducted 38% of total deliveries. These figures indicate that trained help is yet to reach majority of mothers during child birth, in Kalahandi district. After analysis of available data, short term and long term measures to reduce IMR were suggested.

Short term measures:

(1) Providing increased manpower in terms of village health functionaries which include village health guides, trained birth attendants and anganwadi workers.

(2) Training, monitoring and evaluation of village health functionaries and ICDS programme need to be strengthened to improve the quality of health and nutritional services.

(3) Incentives need to be increased to motivate village health guides and trained birth attendants.

(4) Improving awareness of family members with emphasis on mother-in-laws regarding maternal nutrition, antenatal care, intranatal care, postnatal care, care of infants and also utilisation of health facilities.

(5) Among the villages, certain problem villages can be identified based on criteria like socio-economic status, drinking water facilities, distance from medical facility etc.

(6) Providing new health centres/safe delivery homes for clusters of problem villages to cater to the needs of referral services, mainly in term of high risk pregnancies.

Long term measures:

(1) Improvement of transport and communication facilities to nearby health facility.

(2) Improving female literacy.

(3) Better drinking water and sanitation facilities.

(4) Strengthening poverty alleviation programmes.

8.2. INVESTIGATION OF EPIDEMIC DEATHS OF KALAHANDI DISTRICT

Staff members : Dr.G.P.Chhotray
Mr.Anil Kumar
Dr.K.Nagaraj
Mr.A.Mohapatra
Mr.N.S.Marai

Findings from this investigation are presented in the section on Pathology Division. Salient epidemiological aspects and details of verbal autopsy are presented in this section. Dr.K.Nagaraj, SRO of this division was actively involved as part of the team in the investigation of alleged epidemic deaths in Kalahandi district of Orissa. Investigations revealed that, sporadic outbreaks of gastroenteritis and other diarrhoeal disorders were reported from the district Kalahandi which have caused 187 deaths during the period, January to December 1996. During the rapid survey conducted from 31.01.97 to 04.02.97 the team had the opportunity of performing verbal autopsy of the deceased persons with the help of a questionnaire designed by RMRC team.

Since the index case has been reported from Borda CHC area, verbal autopsy was initiated from village Kendulijhar which also registered 15 deaths due to diarrhoeal disorders in the year 1996. The team also had the opportunity in conducting verbal autopsy in Thuamul Bhatguda village and Kathgara village of Thuamul Rampur PHC which contributed to maximum number of deaths due to similar disorders in the same period. It was observed from the findings of 32 deaths that have occurred during 1996 due to diarrhoeal disorders, maximum number of deaths have occurred in young adults in the age group of 21-40 years followed by 0-10 years age group.

The clinical manifestations as described by the relatives and other family members relate to loose motions (3-4 times) of acute onset, accompanied by vomiting (2-3 times) with mild fever. The course and progression of the disease were short and the death occurring between 24-72 hours after the onset of initial symptoms of attack. Appropriate and timely treatment was given by medical/paramedical personnel in the form of ORS/IV fluid, antibiotics etc. in the majority of cases (27/32), which was of no avail. The possible cause attributed to these deaths was related to diarrhoeal disorders.

The team could perform verbal autopsy on three cases out of the five alleged starvation deaths in the village Jodabandha in Narla Block, Saplahara village in

Marlamunda block and Saurapadar village of Keshinga block during their visit. It was observed that three deaths were in the age group of 41-60 years and all were males. Two of them had succumbed to old age related deaths, while the other died of malignancy of stomach (suspected). In one of the old age related deaths, the main complaint was chest pain, the other had a vague clinical manifestations like general weakness. Both of them did not have timely medical care. The third case of suspected cancer stomach was admitted and provisionally diagnosed to be cancer stomach at Dharamgarh SD Hospital. After a brief stay in the hospital the patient left against medical advice and subsequently died having clinical manifestations of fever and pedal edema.

Considering from general outlook and nutritional status as indicated by appropriate body proportions of other inhabitants of these villages from different age groups of both sexes, no gross abnormality could be noticed attributable to nutritional disorders. A separate survey was carried out by another team of RMRC for the assessment of nutritional profile of vulnerable age groups in Kalahandi district during January 1997. That report also indicated satisfactory nutritional status of mothers and children (refer Section on Anthropometry and Nutrition). The recommendations include detailed epidemiological and laboratory investigators to find out the exact cause of the outbreak and mortality due to various diarrhoeal disorders and other causes need to be taken up as soon as possible by health authorities. It was also recommended that social awareness towards raising the standards of living in terms of better health, sanitation and hygiene needs to be propagated through appropriate health education methods. A comprehensive report covering origin of the epidemic, distribution, causative factors and recommendations is presented in Section on Pathology.

(C) EXTENSION AND EDUCATION ACTIVITIES

This Division has taken up a major role in conducting IEC activities with reference to 85th Year Celebrations of ICMR. The details of activities undertaken are given in the next section.

9. EXTENSION AND EDUCATION ACTIVITIES

9.1. HEALTH AWARENESS PROGRAMMES IN CONNECTION WITH 85TH ANNIVERSARY CELEBRATIONS OF ICMR

This Centre has undertaken several health awareness campaigns in different situations regarding prevention and management of various health problems to disseminate information generated by the Indian Council of Medical Research and its institutes/centres in connection with 85th Anniversary Celebrations of ICMR. The Division of Epidemiology and Informatics has taken a major role in organising these activities. Following are the programmes organised in this regard.

1. Health Awareness Programme on Non-Communicable Diseases at Indian Red Cross Society, Bhubaneswar

A health awareness programme on non-communicable diseases was conducted at the headquarters of Indian Red Cross Society (IRCS), Orissa State Branch, Bhubaneswar on 6th June 1996. Shri I.C.Das, General Secretary of IRCS, Bhubaneswar inaugurated the session. About 50 life members of IRCS benefited from the programme. Dr.K.Satyanarayana, Director, RMRC, Bhubaneswar outlined the contribution of ICMR in tackling various health problems in the country. He explained the ways and means of prevention and management of problems like obesity, diabetes, hypertension and cardio-vascular disorders. Dr.K.Nagaraj, SRO explained various aspects of rheumatic heart disease and cancers. Dr.B.V.Babu, SRO spoke on genetic diseases like haemophilia and G6PD deficiency. This programme was followed by lively discussion and a video show on rheumatic heart disease. Dr.M.R.Ranjit, RA, Mr.A.S.Acharya, RA and Ms.R.Mohapatra, SRF have helped in organising this programme.

2. Participation in Seminar on "Nutrition, Maternal Health and Child Survival" on World Population Day

The RMRC, Bhubaneswar was requested to participate in seminar organised by Orissa Association for Population and Development (OAPD) on the occasion of World Population Day on 11th July 1996. Smt. Bijayalakshmi Sahoo, Hon'ble Minister of State for Women & Child Development (Government of Orissa) inaugurated the seminar as the Chief Guest. Dr. K. Satyanarayana, Director, RMRC delivered key

note address as the Chief Speaker and reviewed information available at national level and also at regional level on the seminar topic. The contributions made by National Institute of Nutrition, Hyderabad and other ICMR institutes in improvement of nutritional profile of the country have been highlighted. He also reviewed the contributions of National Institute of Cholera and Enteric Diseases, Calcutta in the field of diarrhoeal disorders and their impact on child survival. Shri R.N. Senapati, President of OAPD and Commissioner-cum-Secretary, Women and Child Development Department, Government of Orissa delivered the presidential address. IEC material on nutrition and diarrhoeal disorders, supplied by NIN, Hyderabad and NICED, Calcutta respectively was distributed to the participants. The posters on diarrhoea and importance of oral rehydration therapy (ORT), prepared by NICED, Calcutta have been exhibited at the seminar venue. About 150 participants from various walks of life including administrators, scientists, University teachers, journalists and students participated in the seminar. About 10 staff members of RMRC were involved in the seminar. A clipping was shown on the Doordarshan in the regional news on the same evening.

3. Health Awareness Programme to Youth Coordinators of Nehru Yuva Kendra Sangathan, East Zone.

In connection with 85th Anniversary Celebrations of ICMR, a lecture-cum-discussion was given by Dr. K. Satyanarayana, Director, RMRC, Bhubaneswar at the Regional Science Centre on 23rd August 1996. It was undertaken for about one hundred youth coordinators of Nehru Yuva Kendra Sangathan and was conducted by Orissa Bigyan Academy in collaboration with National Council of Science and Technology Communications (NCSTC), Department of Science and Technology, Government of India. This programme highlighted the role played by science and technology in improving health and nutritional status in the country. Emphasis was also given to dispel some of the superstitions prevailing on food habits and health behaviour. IEC materials prepared by ICMR institutions were distributed to participants. The posters on diarrhoeal disorders, supplied by NICED, Calcutta were exhibited.

4. Health Awareness Programme to N.S.S. Programme Officers, N.S.S. Regional Centre, Bhubaneswar

A health awareness programme on HIV/AIDS was conducted on 4th September 1996, as a part of training programme conducted by N.S.S. Regional Centre, Bhubaneswar to the programme officers of different universities in Orissa.

Shri M.Satyanarayana, Assistant Programme Advisor, N.S.S., Regional Centre inaugurated the programme. Dr.K.Nagaraj, SRO spoke on clinical aspects and preventive measures regarding HIV/AIDS. Dr.B.B.Pal, RO talked on etiology and pathogenesis of HIV/AIDS. Dr.G.Bulliyya, RO was also involved in this programme. A video cassette titled 'Scourge' on HIV/AIDS was screened and it was followed by question answer session.

5. Health Awareness Programme for Life Members of Indian Red Cross Society at RMRC, Bhubaneswar.

A health awareness programme on vector borne diseases was conducted for life members of Indian Red Cross Society, Orissa State Branch at RMRC, Bhubaneswar on 25th September 1996. About 30 life members of Indian Red Cross Society attended this programme. Dr.K.Satyanarayana, Director spoke on the achievements of various ICMR institutes in different areas of health. Dr.A.P.Dash described various aspects, including control measures of vector borne diseases. Dr.K.Nagaraj, SRO and Dr.B.K.Das, Hon.Fellow spoke on treatment of vector borne diseases and diabetes respectively. The IEC materials supplied by different ICMR institutes were distributed to participants. Later, video films on Japanese encephalitis (JE) produced by Audio-Visual Unit of ICMR and Centre for Research on Medical Entomology (CRME), Madurai and on Air pollution supplied by National Institute of Occupational Health (NIOH), Ahmadabad were screened.

6. Seminar on Vector Borne Diseases at Utkal University, Bhubaneswar.

A special seminar on vector borne diseases was conducted on 1st October 1996 at Utkal University, Bhubaneswar on the occasion of 85th Anniversary Celebrations of ICMR. The participants included university teachers, research scholars and post-graduate students. Dr.M.K.Das, DD discussed the role of immunology in filariasis and presented some interesting research findings. Dr.A.P.Dash, AD gave an overview of vector borne diseases with a special emphasis on vector control measures. Dr.B.Ravindran, AD spoke about the development of various vaccines in general and the current status of vaccine development for vector borne diseases, in particular. Dr.K.Nagaraj, SRO helped in organising the seminar.

7. Popular Lecture Series organised by Solar, a NGO at GOP College, Konark.

In connection with 85th year of ICMR, a team of scientists of RMRC including Dr.K.Nagaraj, SRO, Dr.B.V.Babu, SRO and Dr.J.J.B. Geddam, RO participated in a popular lecture series organised by Solar, a non governmental organisation at GOP College, Konark on 4th October 1996. About 200 students and 10 staff of the college attended. Dr.K.Nagaraj, SRO spoke on etiology, clinical aspects and preventive aspects of AIDS. Later a video show on AIDS (titled 'Scourge') was screened. This programme was conducted with the support of Department of Science and Technology, Government of India.

10. GENERAL INFORMATION

10.1. PUBLICATIONS

Papers published in Journals:

1. Khan, S.A., Kanwar Narain, Handigue, R., Dutta, P., Mahanta, J, Satyanarayana, K. and Srivastava, V.K. Role of some environmental factors in modulating seasonal abundance of potential japanese encephalitis vectors in Assam, India. South East Asian Journal of Tropical Medicine and Public Health, 27 (2): 382-391 (1996).

2. Venkataramana, Y., Vindhya, P., Kapoor, R.N. and Satyanarayana, K. Energy intake, energy expenditure and physical activity pattern of selected sports persons. The Journal of Rehabilitation (Med) in Asia, 1(1): 36-44 (1997).

3. Bal, M.S. and Das, M.K. Antibody responses in human infected with *W.bancrofti*. Parasite Immunology, 18: 473 (1996).

4. Bal, M.S. and Das, M.K. Inhibition of filarial proteases by antibodies from human filariasis. Current Science, 71:519 (1998).

5. Mukhapadhyaya, S and Ravindran, B. Antibodies to Diethylcarbamazine potentiate the antifilarial activity of drug. Parasite Immunology, 19:191-195 (1997).

6. Satapathy, A.K. and Ravindran, B. A quantitative cell-ELISA for α-galactose specific antibodies in human malaria. Journal of Immunology 17(3): 245-256 (1996).

7. Das, B.K., Sahoo, P.K. and Ravindran, B. A role for Tumour Necrosis Factor - α in acute lymphatic filariasis. Parasite Immunology, 18: 421-424 (1996).

8. Bulliyya, G. et al., Fatty acid profile and the atherogenic risk in fish consuming and non fish consuming people. Man in India, 7 (1): 1-13 (1997).

9. Bulliyya, G. et al. Marine fish consumption and atherogenic risk profile. Indian Medical Journal, 91(3): 55-59 (1997).

10. Mukhopadhyay, S., Dash, A.P. and Ravindran, B. *Setaria digitata* microfilaria in *Mastomys coucha*: an animal model for chemotherapeutic and immunological studies. Parasitology, 113: 323-330 (1996).

11. Mohapatra, R., Ranjit, M.R. and Dash, A.P. Effect of chitin synthesis inhibitors on the development of *B.malayi* in *Aedes aegypti*. Journal of Helminthology, 70: 269-270 (1996).

12. Kaeda, J.S., Chhotray, G.P. et al. A new Glucose-6-phosphate dehydrogenase variant, G6PD Orissa (44 Ala → Gly), is the major polymorphic variant in tribal populations in India. American Journal of Human Genetics, 57:1335-1341 (1995).

13. Balgir, R.S., Dash B.P. and Das R.K. Fetal outcome and childhood mortality in offspring of mothers with sickle cell trait and disease. Indian Journal of Paediatrics, 64: 79-84 (1997).

14. Dash, B.P. and Kar, B.C. Possible genetic link of high HbF in Indian sickle cell disease (SS) patients. Indian Journal of Haematology and Blood Transfusion, 13:165-168.

15. Kumar Anil. Human filariasis: Infection rate as uniform criterion for filarial endemicity. J. Commun. Disease, 28(3) (1996).

16. Subramanyam, V.R., Kumar Anil and Mishra, N. A note on parental filariasis as a risk factor for filariasis in children. Biomedical Letters, 5:1407 (1996).

17. Nagaraj, K. and Brahmeswara Rao, B.V.N. Problems of childhood diarrhoea in slums - a case for health education. The Indian Practitioner, 49 (11): 887-890 (1996).

18. Rao, R. S. P. and Nagaraj, K. et al. Influence of parental literacy and socio-economic status on infant mortality. Indian Journal of Paediatrics, 63: 795-800 (1996).

19. Babu, B.V. et al. Distribution of blood pressure and influence of subcutaneous fat on systolic and diastolic levels in a tribal population. Journal of Indian Medical Association, 94: 289-293 (1996).

20. Babu, B. V. et al. Genetic diversity of PTC taste sensitivity among tribal and caste populations of Andhra Pradesh. Zeitschift for Morphologie and Anthropologie, 81(2): 217-221 (1996).

21. Babu, B. V. Association of haptoglobin types with arterial blood pressure. Indian Journal of Physiology and Pharmacology, 41(2): 185-186 (1997).

Papers In Press/Communicated:

1. Ravindran, B. Sahoo, P. K. and Dash, A. P. Lymphatic filariasis and Malaria: concomitant parasitism in Orissa, India "Transactions of the Royal Society of Tropical Medicine and Hygiene" 1997 (in Press).

2. Pal, B.B. and Bhunya, S.P. Genotoxic effect of an insecticide carbaryl in mouse *in vivo* test system. Perspectives of Cytology and Genetics (communicated).

3. Mahapatra, N. Dash, A. P. and Hazra, R. K. Application of Dyar's rule to the development of the two species of *Culex*. Tropical Biomedicine (in Press).

4. Mohapatra, R. Dash, A. P. and Ranjit, M. R. Chitin synthesis inhibitors influence some biochemical parameters in mosquitoes. Tropical Biomedicine (in Press).

5. Chhotray, G. P. and Ranjit, M. R. Sickle cell gene, serum immunoglobin and complement pattern in an endemic area of Orissa. Indian Journal of Haematology (in Press).

6. Chhotray, G.P. and Mohapatra, M. Diagnostic perspective of filarial stain test (FST) by using *B.malayi* L_3 antigen. Journal of Communicable Diseases (communicated).

7. Chhotray, G.P. and Omar A. D. Cyprofloxcine associated biliary cholilithiasis - three case reports. Annals of Saudi Medicine (communicated).

8. Chhotray, G.P. and Mohapatra, M. Type 1 hypersensitive reaction induced by FST by using *B.malayi* L_3 antigen, an experience. Proceedings of National Academy of Vector and Vector Borne Diseases (in Press).

9. Dash, B.P. and Das, R. K. Age, sex and seasonal variation of sickle cell disorder cases in Orissa. Journal of Human Ecology (communicated).

10. Balgir, R.S., Dash, B. P. and Murmu, B. Haemoglobinopathy, G6PD deficiency and blood groups among the tribals of Sundargarh district in Orissa. Indian Journal of Haematology and Blood Transfusion (communicated).

11. Roy, B., Dey, B., Balgir, R.S., Dash, B.P. et al. Identification of Sickle Cell Homozygotes using haematological parameters. Indian Journal of Medical Research (communicated).

12. Bulliyya, G. et al. Traditional fish consumption and fatty acid composition of healthy subjects. Asia Pacific Journal of Clinical Nutrition (in Press).

13. Bulliyya, G., Reddy, P.C. and Reddanna, P. Serum lipids with reference to atherogenic risk in fish consuming and non fish consuming people. South Asian Anthropologist (in Press).

14. Bulliyya, G. et al. Role of dietary fatty acids in coronary heart diseases. Indian Journal of Medical Sciences (communicated).

15. Bulliyya, G. et al. Influence of fish diet on haemostatic variability between fish eating and non-fish eating populations. Thrombosis Haemostatis (communicated).

16. Satpathy, S.K., Jena, R.C., Sharma, R.S. and Sharma, R.C. Status of *P.falciparum* resistance to chloroquine in Orissa. Indian Journal of Communicable Diseases (in Press).

17. Anil Kumar. Bancroftian filarial infection: annual rate of loss and gain in a rural population of Orissa. Tropical Biomedicine (in Press).

18. Nagaraj, K. Babu, B.V. and Pal.B.B. A study on awareness of AIDS and impact of health education on AIDS among rural college students of Orissa state. Indian Journal of Public Health (communicated).

19. Babu, B.V. and Naidu, J.M. Genetic variability of blood and saliva antigens, and serum proteins among sub tribes of Mali from Andhra Pradesh, India. Anthropologischer Anzeiger (in Press).

20. Parvatheesam, C. Babu, B.V. and Babu, M.C. Genetic structure of Rajaka caste and affinities with other caste populations of Andhra Pradesh, India. Zeitschift for Morphologie and Anthropologie (in Press).

21. Babu, B.V. and Parvatheesam, C. Glucose-6-phosphate dehydrogenase deficiency in populations of Andhra Pradesh. The Indian Practitioner (communicated).

10.2. CONFERENCES/SEMINARS/ SYMPOSIA/MEETINGS ATTENDED :

1. Dr.K.Satyanarayana, Director delivered a guest lecture at the Annual Conference of ISPM and IAPH, Andhra Pradesh branches at Sidhartha Medical College, Vijayawada, during 4th-5th April 1996. He has highlighted the achievements of ICMR in connection with the 85th Year Anniversary Celebrations and reviewed the "Recent advances in the nutritional sciences in India".

2. Dr.K.Satyanarayana, Director delivered the key note address in the Seminar on Nutrition, Maternal Health and Child Survival, Organised by the Orissa Association for Population and Development, at Bhubaneswar on 11th July 1996.

3. Dr. K. Satyanarayana, Director attended SAC meeting of Regional Medical Research Centre (RMRC), Port Blair in July 1996.

4. Dr. K. Satyanarayana, Director attended SAC meeting of Regional Medical Research Centre for Tribals (RMRCT), Jabalpur in August 1996.

5. Dr. K. Satyanarayana, Director gave a lecture on health and nutrition of mothers and children in a programme undertaken for youth coordinators of Nehru Yuva Kendra Sangathan by Orissa Bigyan Academy and National Council of Science and Technology Communications on 23rd August 1996 (details are given in section 'Extension and Education Activities').

6. Dr. K. Satyanarayana, Director had a series of meetings at National Institute of Nutrition, Hyderabad, in connection with Kalahandi Child Survival Project during 28th-29th October 1996. Discussions were held with the Director and senior scientists of National Institute of Nutrition.

7. Dr. K. Satyanarayana, Director along with Dr.K.Vijaya Raghavan and Dr. D. Hanumantha Rao of National Institute of Nutrition. Hyderabad met Sri R.N.Senapati, Commissioner-Cum-Secretary, Department of Women and Child Development, Government of Orissa to chalk out the plan of action for Child Survival Project in Kalahandi.

8. Dr. K. Satyanarayana, Director attended the CME Programme on Diet and Diabetes and Annual Meeting of Nutrition Society of India at National Institute of Nutrition, Hyderabad during 20th-22nd November 1996.

9. Dr. K. Satyanarayana, Director submitted an abstract of paper entitled "Childhood nutritional status (CNS), physical work capacity (PWC) and mechanical efficiency (ME) - a rural India study (along with Y.V.Ramana, M.S.Rao and S.S.Rao) which was accepted for presentation in 16th International Congress of Nutrition to be held during 27th July-1st August 1997 in Montreal, Canada.

10. Dr. M. K. Das, DD, Dr. A. K. Satapathy, RO and Ms. M. S. Bal, RA attended 65th Annual Meeting of Society of Biological Chemists (India) at Department of Biochemistry, Indian Institute of Science, Bangalore and presented two papers entitled "Antibody response to parasitic lipids in lymphatic filariasis" and "Filarial proteases and their inhibition by IgG from human filarial sera".

11. Dr. B. Ravindran, DD attended the Garden Research Conference on Parasitism held at Newport, Rhode Island, USA during 6th July-11th July 1997.

12. Mr. P. K. Sahoo, RA attended the XXIII Annual Conference of Indian Immunology Society held at Visakhapatnam on 12th December 1996 and presented a paper entitled "Increased susceptibility of mice with XID mutation to *B.malayi* infection".

13. Ms. Sangita Mukhopadhyaya, SRF attended the XXIII Annual Conference of Indian Immunology Society held at Visakhapatnam on 12th December 1996 and presented a paper entitled "Immunological characterization of a conserved protective carbohydrate filarial antigen". She also got the best poster award for the session.

14. Dr. B. B. Pal, RO attended 20th National Congress of IAMM at Agra during 31st October-3rd November 1996 and presented a paper entitled "Bacteriological profile of acute diarrhoea in Orissa".

15. Dr.A.P.Dash, DD attended National Conference of Public Health Entomologists, held at National Institute of Communicable Diseases, Delhi in June 1996.

16. Dr. A. P. Dash, DD attended the meeting on malaria organised by Orissa Voluntary Health Association (OVHA) at Bhubaneswar in January 1997.

17. Dr.A.P. Dash, DD attended National Seminar on Developmental Biology at Bhubaneswar in February 1997.

18. Dr.A. P. Dash, DD, Dr.N.Mohapatra, SRO and Dr.R.K.Hazra, TO attended Symposium on Vector and Vector Borne Diseases at Goa during 17th-19th March 1997.

19. Dr.A.P.Dash, DD gave a guest lecture on role of sibling species in malaria epidemiology at the State Institute of Health and Family Welfare on the occasion of Malaria Week in June 1996.

20. Dr.G.P.Chhotray, AD, Dr.J.J.B.Geddam and Dr.M.Mohapatra, SRF attended XXIV Annual Conference of Indian Association of Pathology and Microbiology (Orissa Chapter) at Sunabeda, held during 14th-15th September 1996, and participated in the Symposium on lymphatic filariasis.

21. Dr.G.P.Chhotray, AD delivered a guest lecture on G6PD Orissa variant at Department of Anthropology, Utkal University, Bhubaneswar.

22. Dr. G. P. Chhotray, AD attended Annual Meeting of Bombay Haematological Society, held at Tata Cancer Institute, Mumbai, during 13th-14th March 1997 and presented a paper entitled "G6PD deficiency in India with special reference to G6PD Orissa".

23. Dr. G. P. Chhotray, AD attended the Symposium on Vector and Vector Borne Diseases, held at Goa during 17th-19th March 1997 and gave lecture on "Filarial Skin test (FST), a diagnostic perspective".

24. Dr. G. P. Chhotray, AD attended the Symposium on the occasion of World Tuberculosis Day organised by DHS, Orissa and IMA at Bhubaneswar on 26th March 1997.

25. Dr. R. S. Balgir, AD attended National Symposium on Indian Anthropology Today, Society, Culture and Development, at Ranchi during 1st-4th November 1996 and presented a paper entitled "Human Genetics, Health and tribal development in Orissa".

26. Dr. B. P. Dash, RA and Mr.B.Murmu, RA presented papers entitled "An analysis of referred cases of sickle cell haemoglobinopathy and thalassaemia" and "Health and nutritional status of Ashram School Children in Sundargarh district of Orissa" in the National Seminar on Problems of Genetic Disorders and Malnutrition in India, held at Department of Anthropology, Utkal University, Bhubaneswar, during 28th-29th March 1997.

27. Mr. A. Mohapatra, RO attended a seminar on Social and biological dimensions of child health in India, held at University of Delhi, Delhi during 2nd-3rd, November 1996 and presented a paper entitled "Recent MCH status of Orissa".

28. Mr. A. Mohapatra, RO attended a seminar on Public Distribution System in tribal areas of Orissa held at Bhubaneswar during 28th-29th March 1997.

29. Mr. N.S. Marai, RA attended seminar on Problems of Genetic Disorders and Malnutrition in India held at Utkal University, Bhubaneswar during 28th-29th March 1997 and presented a paper entitled "Maternal and child health and nutritional profile of Kalahandi district of Orissa."

30. Dr. R. C. Sharma, AD attended 84th Indian Science Congress at Delhi in January 1997 and presented a paper entitled "Operational field research priorities in malaria control in India".

31. Mr. R. K. Das, RA participated in the 4th International Congress on Alternative Medicines, on the occasion of World AIDS Day, at Calcutta during 1st-3rd December 1996.

32. Mr. Anil Kumar, AD attended XIV International Scientific Meeting of International Epidemiological Association held at Nagoya, Japan during

27th-30th 1996 and presented a paper entitled "A study of risk factors of filariasis transmission in Khurda district of Orissa".

33. Dr. B. V. Babu, SRO attended a National Seminar on Problems of Genetic Disorders and Malnutrition in India at Department of Anthropology, Utkal University, Bhubaneswar and presented a paper entitled "Effects of inbreeding on mortality and morbidity: genetic and epidemiological perspectives".

TRAINING OBTAINED BY THE STAFF MEMBERS:

1. Dr. B. B. Pal, RO attended a Workshop on HIV/AIDS Surveillance conducted by NACO, New Delhi in Calcutta during 13th-14th February 1997.

2. Dr. R. K. Hazra, TO was awarded the Ph.D. degree by the Utkal University, Bhubaneswar under the guidance of Dr.A.P.Dash, DD for his thesis entitled "*Mansonioides* mosquitoes of Orissa with reference to filariasis".

3. Mr. R. K. Das, RA participated in the Workshop on "Holistic Healing Course" and "Aromatherapy Training" of 4th International Congress on Alternative Medicines, organised by Indian Board of Alternative Medicines, Calcutta during 4th-5th December 1996.

4. Mr. R. K. Das, RA completed the course of "Training-cum-Treatment camp on Naturopathy" organised by National Development Organization, Cuttack, at Puri during 25th-31st December 1996.

5. Mr. R.K.Das, RA participated in the Skill-cum-Technology Upgradation Programme (STUP) on Medicinal and Aromatic Plants, organized by Central Institute of Medicinal and Aromatic Plants (CSIR), Lucknow at Central Rice Research Institute (ICAR), Cuttack during 22nd-24th January 1997.

6. Dr. K. Nagaraj, SRO, Dr.B.V.Babu, SRO, Mr.A.Mohapatra, RO, Dr.J.J.B.Geddam, RO and Dr.G.Bulliyya, RO participated in the training programme in connection with Nutritional Profile of Indian districts, by senior scientists from National Institute of Nutrition, Hyderabad at Choudwar during 20th-25th August 1997.

7. Mr. A. S. Acharya, RA underwent extensive course in programming and Application of Electronic Computer at Indian Statistical Institute, Calcutta during 29th October 1996 - 4th January 1997.

8. Mr. A. S. Acharya, RA underwent training on general information service terminal (GISTNET) at National Informatics Centre, Bhubaneswar on 4th February 1997.

10.3. OTHER ASSIGNMENTS AND RECOGNITIONS:

1. Dr. K. Satyanarayana, Director was elected as Executive Member of Nutritional Society of India, being a Convenor of Bhubaneswar Chapter of NSI. He chaired prize awarding session on Community Nutrition at Annual Meeting of NSI.

2. Dr. M. K. Das, DD was nominated as a member of scientific selection Committee of Indian Institute of Chemical Biology (CSIR), Calcutta.

3. Dr. M. K. Das, DD was appointed as examiner for examining Ph.D. thesis and he has conducted a Ph.D. viva-voce examination in Department of Biochemistry, Banaras Hindu University, Varanasi in October 1996.

4. Dr. M. K. Das, DD was invited to give lectures on immunology to M.Sc. (Zoology) students in Utkal University, February 1997.

5. Dr. B. Ravindran, DD visited to University of Connecticut Health Centre, Farmington and Yale University, New Heaven, USA availing a WHO fellowship for 9 months from January-September 1997.

6. Dr. B. Ravindran, DD was nominated as a member of Evaluation Panel of Biological Testing Laboratory by DST, New Delhi.

7. Dr. B. Ravindran, DD visited Astra Research Centre, India, Bangalore as an advisory consultant for their research programme on malaria.

8. The European Commission has approved and sanctioned a project to Dr.B.Ravindran, DD as Principal Investigator on "Immunology of lymphatic filariasis modulation variation and immunity". The project is to be undertaken in collaboration with Prof.Rick Maizels for a period of 2 years.

9. Dr. Bidyut K. Dash, Research Scholar visited to Sanjay Gandhi Institute of Post Graduate Medical Science at Lucknow for 2 months availing the P.N. Derry Fellowship.

10. Ms. Sangita Mukhopadhyaya, SRF submitted her thesis entitled "Experimental filariasis in *Mastomys* natalensis an immunological study" to Utkal University for Ph.D. degree in December 1996.

11. Dr. A. P. Dash, DD acted as Chairman of the scientific session on impregnated bednets in malaria control organised by the British Council Division at Bhubaneswar on 14th March 1997.

12. Dr. R. S. Balgir, AD was appointed as examiner for M.Sc./M.A. Biological Anthropology by Department of Anthropology, Vinoba Bhave University, Hazaribag.

13. Dr. R. S. Balgir, AD has been selected for publication of his biography in "International Directory of Distinguished Leadership-1997", Carolina, USA and "Asia/Pacific Who's Who-1997" New Delhi.

14. Mr. R. K. Das, RA was awarded "Shiromani Award" in recognition of dedicated services in Holistic Health and Healing, on the occasion of 4th International Congress of Alternative Medicines, Convocation and Award Presentation Ceremony, Organised by Indian Board of Alternative Medicines, Calcutta on World AIDS Day, 1st-3rd December 1996.

15. Dr. K. Nagaraj, SRO attended as a resource person in a workshop conducted by DANLEP on "Health systems research in Leprosy" at Puri during 20th-29th January 1997.

10.4. SCIENTIFIC ADVISORY COMMITTEES OF THE CENTRE

Members of the 10th Scientific Advisory Committee:

1. Dr. D. S. Agarwal — **Chairman**

   Professor and Head Department of Microbiology
   University College of Medical Sciences
   and Guru Teg Bahadur Hospital
   Shahadara, Delhi 110 095.

2 Dr. V. Dhanda (late)
Director,
Vector Control Research Centre
Medical Complex, Indira Nagar
Pondicherry 605 006.

3 Dr. M. K. K. Pillai
Dept. of Zoology
Delhi University
Delhi 110 006.

4. Dr. V. Sitaramam
Dept. of Zoology
University of Poona
Ganeshkhind
Pune 411 007

5. Dr. B.B.Tripathy
Retd. Prof. of Medicine
Saradiya Mission Road
Cuttack 753 001

6. Dr.V. P. Sharma
Director
Malaria Research Centre
22, Shamnath Marg
New Delhi 110 054

7. Director General of Health Services,
O/o. DGHS, Nirman Bhawan,
New Delhi.

8. Dr. D. A. Gadkari
Director
National Institute of Virology
20-A, Dr.Ambedkar Road
Post Box No.11
Pune 411 001

9. Dr. L. N. Mohapatra
Ex-Director, RMRC
GM-10, V.S.S. Nagar
Vani Vihar
Bhubaneswar-751 004

10 Dr. R. S. Tiwary
Director
Regional Medical Research Centre
R.M.R.C. Complex, Nagpur Road
Jabalpur 482 003

11. Dr. Sudha G. Gangal,
Director,
Bai Jerbai Wadia Hospital for
Children and Institute of Child
Health Research Society,
Acharya Donde Marg,
Parel, Bombay-400 012.

12. Dr. Manorama Bhargava
Professor and Head
Department of Haematology
A.I.I.M.S.
Ansari Nagar
New Delhi- 1100 029.

13. Dr. Dipika Mohanty
Director,
Institute of Immunohaematology (ICMR)
New Multistoried Building
13th floor
KEM Hospital Campus,
Parel,Bombay-400 012

14. Dr. R.K. Chatterjee
Scientist 'F'
Division of Parasitology
CDRI, Lucknow

15. The Addl. Secretary
Health Services
Orissa Secretariat
Govt. of Orissa
Bhubaneswar

16 The Director
Health Services
Heads of Dept. Building
Govt. of Orissa
Bhubaneswar

17. Director
Medical Education & Training
Heads of Dept. Building
Govt. of Orissa
Bhubaneswar

18 The Principal
M.K.C.G. Medical College
Berhampur
Dist. Ganjam

or

The Principal
S.C.B. Medical College
Cuttack, Orissa

or

The Principal
V.S.S. Medical College
Burla
Dist. Sambalpur

or

The Principal
Medical College
Visakhapatnam

19. Dr. M. Mohan Ram
Director, National Institute of Nutrition
Jamai Osmania
Hyderabad- 500 007.

20. Dr.K.Satyanarayana (Member-Secretary)
Director
Regional Medical Research Centre
Chandrasekharpur
Bhubaneswar 751 023.

The above Scientific Advisory Committee (SAC) which was constituted in June, 1996 met only once on 23rd July, 1996 and considered the Annual Report of 1995-96 and gave recommendations on the new projects. Among its members Dr.P.K.Das, Director, VCRC, Pondicherry replaced late Dr.V.Dhanda, Ex-Director, VCRC, Pondicherry at Serial No.2. Dr.Kamala Krishnaswamy (Serial No.-19), Director, NIN, Hyderabad replaced Dr.M.Mohan Ram, Ex-Director, NIN, Hyderabad. Among the 4 medical colleges listed at Serial No.18, the Principal, VSS Medical College, Burla was the member for the period between 1996-98.

Several new projects for extramural funding [WHO/TDR; European Commission Union (ECU); DBT, Government of India] and intramural projects were circulated to the above SAC members and their comments and recommendations were obtained. Based on these recommendations, new projects were forwarded to the Council for necessary action and onward transmission to the funding agencies.

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10.5. THE BUDGET ALLOCATION FOR THE CENTRE BY THE COUNCIL AND EXTRAMURAL FUNDS

The Council has released a total of about Rs.98 lakhs for this Centre during 1996-97. About a sum of Rs.64 lakhs was towards Pay and Allowances. About Rs.21 lakhs was released for 'other charges'. A sum of Rs.3.3 lakhs was released for TA during the year. A sum of Rs.4 lakhs towards equipment and a sum of Rs.4.83 lakhs towards capital was released during the year 1996-97.

The WHO/TDR project on **"Field evaluation of *B. sphaericus* against *Cx. quinquefasciatus* in Orissa"** shown as section 5.3 of 1996 - 97 Annual Report has been in operation from 1992. Dr. A.P. Dash, DD is the P.I. of this multicentric project. A balance of Rs. 3.4 lakhs was available in April 1996. During June 1996, a sum of Rs. 2.6 lakhs was received from the funding agency. Out of the total Rs. 6 lakhs available, a sum of Rs. 4 lakhs was used during the year 1996 - 97, leaving a sum of Rs. 2 lakhs for continuation of the project in 1997 - 98.

10.6. ANNUAL REPORT COMMITTEE

Dr. K. Satyanarayana, Director	Chairman
Dr. B. Ravindran, D.D	Vice-Chairman
Dr. B. Veerraju Babu, S.R.O.	Secretary
Mr. S. K. Parida, T.O.	Member
Mr. A. S. Acharya, R.A.	Member
Mr. P. C. Nayak, P.A.	Convenor

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