DISCUSSION
The present study was conducted on 40 children of measles of different nutritional grades. They were classified into well nourished and malnourished group depending on Harvard weight/age standard. The study group children were age matched with control group children. Both the study and control group children were investigated for immunological profile by T cell count and DNCB skin test (for cellular immunity) and B cell count (for humoral immunity). Before evaluating the immunological status of these children total leucocyte count (TLC), Differential Leucocyte Count (DLC), Haemoglobin (Hb) and Erythrocyte Sedimentation Rate (ESR) estimation was done of every case. While no significant variation was observed in Total Leucocyte Count (TLC) when values compared between study and control group children, Hb and ESR values were found to be in direct proportion of nutritional status and ESR values were observed to be in inverse proportion of nutritional status. The high ESR values in malnourished study group children could be explained on the basis of severity of anemia in malnourished children as well as due to intercurrent infections observed frequently during measles.
PHYSIOLOGICAL STATUS OF HEALTHY CHILDREN ACCORDING TO AGE AND SEX

No significant variation was observed in immunological parameters eg. T cell, B cell and absolute counts in control group children of either sex and among different age groups. Beside this no significant difference in responsiveness to DNCB contact sensitization was observed in either sex. Our observation are well supported by previous studies, Wybran et al (1973) and Neiburger (1976) found no difference in resetting values in healthy adults and infants, which could be attributed to age or sex. However Fleischer et al (1975) found T cell percentage significantly, lower in the younger than older children and adults. B cell percentage was significantly higher in younger children than older children and adults. However because the young children had absolute lymphocytosis, so the absolute number of T cell was higher in younger children than older children and adults.

Twenty (42) of our study group children belonged to age group between 2-6 years, and out of total 42 cases 26 (70%) were below 4 years of age. The age of study group children ranged between 8 months
and 12 years. No case was seen below 6 months of age.
As revealed by previous studies (Marley D 1969), measles is a disease of younger children in developing countries, while in developed countries like United Kingdom and Europe the disease occurs in children above 3 years of age. The maximum age incidence in this study was same as observed by earlier workers (Ferreira and Benazina 1972, Krishnamurthy and Anantharaman 1974, Marley D 1976 and Rameshwar P et al 1984).

IMMUNOLOGICAL PARAMETERS IN CONTROL AND STUDY GROUP

Insignificant change in lymphocyte count percentage and absolute count was observed in well nourished measles children when compared to control group. However lymphocyte percentage and absolute lymphocyte count was significantly lowered in malnourished children with measles as compared to control. There could be two reasons of lymphopenia in malnourished children first, as suggested by Smythe et al (1972) that a preexisting state of malnutrition might produce diminution of cell mediated immunity via reduction in the population of thymus dependent lymphocytes and second being immunosuppression due to the atrophy of thymus (White and Boyd 1973) which is frequent in children dying
from measles. Joseph et al have attributed this
immunosuppression replication of measles virus
in T and B lymphocytes in the peripheral blood which
may lead to destruction of these cells thus contributing
to depletion of lymphocytes. It has been suggested
(Whittle et al 1980, Dooseter et al 1977) that lymphocytes
of children with malnutrition are abnormally susceptible
to infection by measles virus. The infection is followed
by a normal cellular and humoral immune response. As a
result, severe damage occurs and this response generates
immunosuppressive factors in the patient's plasma thus
making the child susceptible to secondary infection.

**Polylymphocytes in control and study group**

As evident from previous studies (Smythe et al
the various causes contributing to Polylymphocytopenia
have been found to be preexisting state of malnutrition,
atrophy of thymus and replication of measles virus in
peripheral blood lymphocytes and all contributing to
depression of cell mediated immune response. In this study
the Polylymphocyte count as well as absolute count were
found to be significantly reduced following acute measles
during 0-7 days of appearance of rash in children who
were belonging to malnourished study group. The measles children of wellnourished group had no significant change in lymphocyte, but had a significant difference in T-cell count when compared to control.

Previous studies (Rashid et al. 1986, Ran Dagan et al. 1987 have also indicated a significant depression in T-lymphocyte subsets following acute measles. A significant degree of immunosuppression in cellular immunity (T-lymphocyte subset) have been observed in malnourished children as compared to well nourished measles children.

Correlation between T-cell subset and degree of malnutrition

It is clear from above account that severity of malnutrition has direct correlation with depression of cell mediated immunity. As postulated earlier by Smythe et al. (1971), a preexisting state of malnutrition in measles can abolish the cellular immune response via reduction in the population of thymus dependent lymphocytes. Contrary to this and our study, Whittle has demonstrated that in malnourished children, although peripheral blood mononuclear cells (PBMC) support a higher replication of measles virus, their cellular immunity does not seem to differ from that in well nourished
children (Bosketar J et al 1977). Studies by Bhaskaran et al (1984) have indicated that there is an equal degree of immunosuppression in both malnourished as well as well nourished children. However, their subsequent studies have revealed a significant depression in circulating T-lymphocytes, in severely malnourished children compared to those of other nutritional grades. Recent studies by Ron Dagon et al (1987) have also shown that there was a more impressive depression in T-cell count than the B cell in malnourished children.

**B-lymphocytes in control and study group children**

Previous studies by different workers (Whittle M C and Bosketar 1978, Ron Dagon et al 1987) have found no significant change in B cell profile following acute measles. However, Coovadia et al (1978) have observed a significant depression in both T and B cell number following acute measles during first few days of the rash. Our studies support the observations of Whittle and Bosketar (1978) and Ron Dagon et al (1987). No significant depression in B cell percentage and absolute count has been observed in this study except for moderate to severely malnourished children who had a relative depression in B lymphocyte percentage and absolute count.
of our control group children responded to DNBC.

It has been observed that the negative DNBC reaction was related to degree of malnutrition. Severe the malnutrition higher the negative reaction to DNBC. The depressed DNBC reactivity was significant in grade II and grade III malnutrition children with measles (70% and 40% respectively). DNBC response in well nourished measles children in our study is comparable to previous study (Whittle H C and Bradley Moore 1973), who found DNBC response positive in 94% of measles children as against 80% positive in our study group children. Study comparing DNBC skin contact response in malnourished and well nourished measles children was not done to our knowledge.

**Correlation between DNBC reactivity and T cell count**

The skin contact sensitization with DNBC is a test of the ability to process a new antigen and initiate, denovo a (cell Mediated Immune) CMII response. As evident from table XI and XIV, DNBC reactivity had direct correlation to T cell percentage in all the 48 measles children. 33 malnourished children who had severe T-lymphocytopenia responded poorly to DNBC skin contact sensitization (77.7%, 73% and 40% respectively). While rest 15 well nourished measles children had a significantly better responsiveness to DNBC (65%) when compared to control.
(90%). Our observations support the study of Sanjeev Rao et al (1981) who found more negative reaction to DNBC contact sensitization in malnourished children when compared to control. It has been suggested that severe the degree of malnutrition more negative the response to DNBC. As postulated earlier by Smythe et al (1971), a preexisting state of malnutrition in measles can demolish the cell mediated immune response via reduction in the population of T-lymphocytes. Therefore one can infer that DNBC response is significantly depressed in measles when it is accompanied with malnutrition. Many studies (Smythe et al 1971, Chandra et al 1972, Betsey G Bang 1973 and David McNarry 1981), highlighted the DNBC skin reaction as a test of cellular immunity in malnourished children and found that they did not respond well to DNBC.

Correlation of measles, malnutrition and complications

Many studies by different workers have highlighted the synergistic impact of measles and malnutrition on the host. There is little doubt that severe malnutrition has profound influence on disease resistance mediated by impairment of immune function. Different reasons have postulated that measles is severe in malnourished children owing to defect in the formation of activated lymphocytes. It has been suggested (Whittle et al 1980, Desester et al 1977), that lymphocytes of children with malnutrition are abnormally susceptible to infection by measles virus, the impaired cellular immune response allows wide spread infection.
with virus. Eventually when the immune response is raised a large number of infected cells are destroyed resulting in extensive allergic damage. The cause of frequent secondary infection was not discussed, but it is generally assumed to be a consequence of the cellular energy that follows measles. It is clear from above account that a preexisting state of malnutrition might produce diminution of cell mediated immunity via radiation in the population of T-lymphocyte (Smythe et al 1971), attributed to thymic dysplasia (Roberts P F 1973) and due to abnormal susceptibility of lymphocytes to infection by measles virus which could predispose to severe or fatal measles.

Our study provide strong evidence for a reduction in cell mediated immune function in children who were under weight for the age. However our results are in contradiction with other workers Whittle et al (1980) and Bhaskaran et al (1984), who reported equal degree of immunosuppression in both well nourished and malnourished children, but they have noted a significantly lowered cellular immune response (T-lymphocyte percentage) in severely malnourished children in their further studies (Bhaskaran et al 1986). In view of these observations, including ours, it could be deduced that a preexisting
state of malnutrition demolish the cellular immune response in measles and further aggravates the complications and flare up the latent infections.

Our study was a prospective investigation of the development of impaired cellular immune response in different grades of malnourished measles children. While others (Bhaskaran et al 1986, Ron Dagon et al 1987), have not highlighted it in children of different nutrition grades including different age groups of children.

When age incidence of complications was studied, it was particularly observed that majority of the study group children aged below 4 years were found to have maximum complications (66%). The older children (4–12 years) had complications in 50% of cases only. Our observations are well in accord with previous studies (Sundaravalli et al 1979). Darai Rajan and Krishnasurthy (1973) have also observed maximum complications in children below 3 years. Coovadia et al (1973) observed a high morbidity and mortality in infants during measles. The poor nutrition was found to be a major contributing factor.

While studying the incidence of various complications, this study has observed respiratory complications in
maximum number of cases (69.2%) followed by gastrointestinal (23%) and then neurological (7.7%). The data are fairly in accord with previous studies (Silhar and Maru, 1958, Ghosh and Dhatt 1961, Desai and Churabah 1967) which also indicated highest incidence of respiratory complications in 87.3%, 56.6% and 37% of cases respectively. When correlation was established between nutritional status and complications it was noted that 68% (33) of our study group children were malnourished and 75% of these children were found to have measles associated complications. A significant difference in mortality was observed in well nourished children with measles which numbered 15 (32%) and complications were found in 33% cases only.

Being hospital based study this does not reflect the true incidence of complications in measles, and is bound to differ from field studies. It can be presumed that serious and sick children were brought to seek medical advice in the hospital, therefore we found increased concentration of complicated cases in our study. However our observations are supported by reports from previous studies (Ghosh and Dhatt 1961, Krishnamurthy 1979), who also observed a greater number of complications among malnourished hospitalized children with measles.