



# NEFI BULLETIN

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## HIV infection and nutrition

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In 1981, in the USA, a disease of unknown etiology was reported in intravenous drug users and in young men who had sex with men. It was characterised by severe acquired immune deficiency and repeated morbidity due to infections, leading to progressive weight loss and a fatal outcome within a short period. The syndrome was termed as Acquired Immuno Deficiency Syndrome (AIDS). In the next two years several hospitals across North America, Western Europe and Australia reported AIDS cases. During the same period, a rapidly fatal disease in young men and women and young children (Slim's disease) was reported from sub-Saharan Africa. Slim's disease was characterised by repeated infections and severe wasting. In 1984, the virus responsible for AIDS-Human Immune deficiency Virus (HIV) was isolated, and the following year ELISA tests for detection of antibodies to this virus were developed. Serological testing of affected persons with wasting in developed countries and Slim's disease in sub-Saharan populations showed that both these are due to HIV infection. In the 1980s, weight loss of 15% or more was one of the major criteria used for determining the possible presence of AIDS. Initial efforts, mostly in developed countries, to combat wasting in persons with AIDS, resulted in neither substantial improvement in nutritional status nor increase in longevity in these patients who were in the terminal phase of HIV infection.

Long term follow up of HIV infected persons detected in the asymptomatic period of HIV infections showed that

contrary to the initial belief, HIV infection is a chronic disease with a long, asymptomatic period, and that immune deficiency, infections, and wasting occurred only in the terminal phases. Persons who had been optimally nourished prior to being infected with HIV, and continued to be well-nourished, remained asymptomatic for longer periods. Undernutrition whether due to food insecurity or infections hastened the drop in CD4 (T-helper cells) counts and progression of the disease. In the last decade, massive improvement in access to generic antiretroviral therapy (ART) for HIV infection has dramatically improved survival, longevity, wellbeing, nutrition and quality of life of HIV infected persons. However, the use of ART is not without problems - obesity and metabolic syndrome have been reported in long term ART users.

There are major differences in the nutritional status of HIV infected persons depending upon whether they are citizens of developed or developing countries, their economic status, route of infection, response to the virus, stage of the disease at the time of detection, type of opportunistic infections, and access to antiretroviral treatment, essential healthcare, and nutrition services. Since mid 2008, food inflation has emerged as a major threat to food security, nutritional status and the use of ART in HIV infected persons in countries in sub-Saharan Africa. All these factors and their complex interactions have to be taken into account in assessing HIV infection-nutrition interactions and planning appropriate interventions to sustain / improve the nutritional status of HIV-

infected persons.

### Prevalence of HIV infection: Global perspective

UNAIDS estimated that, globally, in the year 2010<sup>1</sup>:

- ~34 million persons were infected with HIV, of whom ~3.4 million were children
- approximately half of the infected adults were women
- 490,000 HIV-positive women delivered babies; and
- 1.8 million deaths were attributable to AIDS.

The prevalence of HIV/ AIDS is highest in sub-Saharan Africa, with some countries of the region reporting that >25% of persons in the reproductive age group are infected.

Globally, in most regions the HIV epidemic curve has plateaued, and it is expected that henceforth there will be a progressive reduction in new cases. Even though no more than one-third of those requiring ART are able to access it, there has been a significant reduction in AIDS-related morbidity and mortality. Of all the modes of transmission, mother-to-infant transmission is the

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most amenable to public health intervention; therefore a goal has been set to eliminate mother-to-infant transmission of HIV by the year 2015<sup>2,3</sup>.

### Scenario in India

India was among the later countries to be affected by HIV infection, and also among the least-affected countries. The data from an unlinked anonymous testing for HIV infection, taken up as a part of the National Family Health Survey-3<sup>4</sup> estimated the prevalence of HIV infection as only 0.36/100. However, because India is a population billionaire, the number of persons with HIV infection in the country was ~2.2 million. In the year 2009, the National AIDS Control Organisation (NACO)<sup>5</sup> estimated that sero-prevalence of HIV was 0.31/100 (0.36/100 in men and 0.25/100 in women); the estimated number of persons infected with HIV was 2.4 million (CI 1.9-3.1 million). There has been a progressive decline in the seropositivity rate from 0.36/100 in 2006 to 0.31/100 in 2009, and in estimated new infections annually from 0.27 million in 2000 to 0.12 million in 2009. There has been a progressive increase in:

- the number of persons attending the counselling and testing centres and undergoing screening for HIV infection;
- the number of seropositive persons receiving appropriate care including ART; and
- the number of pregnant women undergoing HIV testing as part of antenatal care, and receiving ART where indicated.

With improvement in access to health and nutrition care, it is expected that the country will be well placed to achieve the national and global goals as regards reduction in the rates of new infections, morbidity and mortality associated with HIV/AIDS.

### HIV infection and nutritional status

It is important to recognise that the nutritional status of HIV infected persons are affected not only by HIV infection and opportunistic infections but also by numerous factors extraneous to HIV infection<sup>6,7</sup>. Undernutrition is a major problem in HIV infected persons. For many persons with HIV infections who are unable to be fully gainfully employed the real challenge is to grow enough food or earn

enough money to purchase food. Agricultural and social welfare policies may be necessary especially in sub-Saharan Africa to alleviate food insecurity among individuals with HIV/AIDS and their families. Adequate balanced diets are essential to maintain HIV infected person's immune system, to sustain healthy levels of physical activity, and for optimal quality of life and so food may be viewed as the first medicine<sup>8</sup>.

### Effect of nutritional status on course and outcome of HIV infection

Most of the data on the effect of nutritional status on the course and outcome of HIV infection are based on studies carried out in developed countries. HIV-associated weight loss and wasting have been shown to be independent contributing factors to poor clinical outcomes in HIV/AIDS. Undernutrition hastens the progression of the disease as indicated by reduction in CD4 counts and increased susceptibility to opportunistic infections. Low body mass index (due to chronic inadequacy in food intake, and/or wasting associated with HIV infection and other infectious diseases), at the start of ART is an independent important predictor of early mortality<sup>6,7,8</sup>.

### Nutritional requirements of HIV-infected persons

Numerous studies both in developed and developing countries have investigated energy requirements, nutritional status, and body composition of HIV-infected persons, from the asymptomatic phase through symptomatic phases<sup>12</sup>. Resting energy expenditure (REE) has been shown to be higher even in the asymptomatic phase (a computed relative increase of 10%) in both adults and children. REE levels are much higher in persons with secondary opportunistic infections. An additional increase of 20–50% in energy needs is found during convalescence after a severe infection, both in adults and in children infected with HIV. Whole-body protein turnover has been reported to be ~25% higher in untreated HIV-infected individuals than in HIV-negative controls. The increase in protein turnover is positively correlated with increase in REE. There is no evidence of protein requirement over and above that required in a balanced diet to satisfy the total energy requirements (12 to 15% of the total energy intake)<sup>8,9</sup>.

The increase in energy needs may not be met due to a variety of reasons including poverty and food insecurity (reported to be a major problem in some sub-Saharan countries), loss of appetite and decreased absorption of nutrients; malabsorption of fat is an especially important factor, caused by gastrointestinal complications. If the increased energy and protein needs are not met, fat and protein stores are oxidised to meet the body's energy requirements, resulting in weight loss in adults and growth failure in children. The loss of body protein could further compromise the immune system of the HIV-infected individual. The magnitude of weight loss varies among individuals, with a  $\geq 10\%$  loss over the period of a year being common. Acute weight loss is often seen in persons with secondary infections. Once the secondary infections are successfully treated and energy intake is increased to adequate levels, patients are able to regain weight and remain weight-stable. Instances of chronic weight loss are usually associated with secondary gastrointestinal infections and consequent malabsorption or (in developing countries) coexisting tuberculosis infection. Anti-TB treatment, where required, results in improvement in body weight. When energy needs are met fully, fat stores are replenished more readily than protein stores. Indeed, over the last decade, there have been reports, initially from developed countries but later also from developing countries, that some HIV-infected persons on long-term ART are becoming obese and developing metabolic syndrome<sup>9</sup>.

### Effect of food supplementation on course and outcome of HIV infection

Interventions to improve the nutritional status of HIV-infected persons varied widely from food-based interventions (diets high in energy, protein, or fats), oral supplements with specific nutrients, enteral and total parenteral therapy, appetite stimulants and anabolic hormones. Although there has been relatively large-scale humanitarian food assistance to improve the nutritional status of HIV-infected persons, both in developed and developing countries, there is very little information on the effectiveness of macronutrient supplementation, whether in improving nutritional status or in improving the course and outcome of HIV infection. A Cochrane review<sup>9</sup> found only eight small, randomised controlled trials

(RCTs) (combined sample sizes for the various outcomes range from 128 to 178 participants) in which the effect of macronutrient supplementation was compared with that of placebo or of no nutritional supplementation. The review found that balanced nutritional supplements aimed at improving energy intake by 600-960 kcal/day did result in improvement in energy and protein intake; specific nutritional supplements increased body weight and decreased HIV viral load, but the clinical outcome of HIV infection remained unchanged. Most of these trials were conducted in either North America or Europe and evaluated well-nourished males and females between the ages of 30 and 50 years who were receiving ART. Variations in the nutrient composition of the supplements, differences in the disease stage of the participants (which can significantly affect intake and absorption of food), exclusion of patients with acute opportunistic infections (who are most prone to weight loss and most likely to experience improvements in nutritional status such as weight gain), are some of the other major limitations of these RCTs.

The observations from these studies may not be applicable to developing countries, where undernutrition is common even in normal persons and asymptomatic HIV-infected persons. The Tuberculosis Research Centre, Chennai<sup>10</sup>, conducted a prospective interventional study between June 2005 and December 2007 to evaluate the effects of macronutrient supplementation for HIV-infected adult patients. Patients at one of the centres received nutritional counselling and standard care only, whereas patients at other centres also received a macronutrient providing 400 cal and 15 g of protein daily. Of the 636 ART-naive patients enrolled in the study, a 6-month follow-up was completed in 361 (282 of those who received supplements and 79 on standard care). There was some increase in body weight, body mass index, mid-arm circumference, fat-free mass, and body cell mass in the group that had received supplements. Weight gain was greater in patients who had CD4 cell counts >200 cells/mL at the start of the study. There was no change in CD4 count in the group receiving supplements, whereas CD4 count decreased in the control group. After adjusting for baseline differences, none of these changes was statistically significant, suggesting that macronutrient supplementation did not

result in significant improvement either in nutritional status or in the course of the HIV infection. A similar study on nutrition supplements from Vellore also failed to show any significant improvement following food supplementation<sup>11</sup>.

The absence of any positive impact of food supplements might be due to the fact that the impact of food supplementation has not been assessed in those who were undernourished at the start of the study. The parameters to indicate individuals most likely to benefit from food supplementation have not yet been clearly established and whether food supplements provided were appropriate to meet the needs of the HIV infected persons have not been explored.

### **HIV infections and micronutrients**

Like many other infections, HIV infection too may impair micronutrient intake and alter micronutrient requirements. Micronutrient status and micronutrient deficiency may accelerate the progression of the disease, increase morbidity, and increase the risk of mother-to-child transmission. Both in developed and developing countries micronutrient supplements have been widely used in the clinical care of HIV-infected persons in various stages of the infection. However, there is very little evidence to confirm the beneficial effects of micronutrient supplementation on the course or outcome of the disease. In Africa, several micronutrient supplementation studies have been carried out in HIV-infected pregnant women<sup>12</sup>. This could be because micronutrient deficiencies were found to be common in pregnant women, supplementation through antenatal clinics was relatively easy, and the outcome of pregnancy as well as mother-to-child transmission rates can be readily measured and documented. Some trials have shown that selenium and zinc may be beneficial, but these results are not conclusive. One trial reported that a daily high-dose multivitamin supplement may not only reduce adverse pregnancy outcomes and mother-to-child transmission, but also considerably reduce progression of HIV infection in pregnant women. These findings have not been confirmed. However, high dose vitamin supplementation, especially fat soluble vitamins supplements, may have adverse consequences. One trial showed that supplementation with vitamin A and  $\beta$  - carotene actually

increased mother-to-child HIV transmission. However, this finding too has not been confirmed by other trials. Besides these, there are also unconfirmed reports that high doses of vitamins B, C and E supplements reduce postnatal mother-to-child HIV transmission.

To sum up, the available data on the effects of micronutrient supplementation on the course and outcomes in HIV infection are inconclusive, both as regards supporting the claims of beneficial effects and allaying the concern that supplementation may have adverse consequences. Part of the observed variation in outcomes might be attributable to the pre-existing micronutrient intake and status of the patient, whether or not the patient is receiving ART, and the stage of HIV infection. In addition, the nutritional status as regards other nutrients may modify the effects of micronutrient supplementation. Micronutrient supplementation cannot and should not be used as a substitute for ART, which is the sheet-anchor of the strategy for prevention of mother-to-child transmission and for treatment of maternal HIV infection.

There is evidence from randomized clinical trials in HIV-infected children and non-HIV-infected subjects that the administration of large doses of vitamin A (a single large dose of 50 000 IU before 6 months; a single dose of 100,000 IU between 6 and 11 months; a single dose of 200 000 IU every 6 months from the age of 12 months onwards) reduces diarrhoea-related morbidity and mortality and all-cause mortality in severely vitamin A-deficient children younger than 5 years of age. In many developing countries subclinical vitamin A deficiency is common, and vitamin A supplementation may be effective as an adjuvant treatment in such persons; however, its impact in those who do not have vitamin A deficiency has to be assessed<sup>12</sup>. Appropriate treatment of diarrhoea is an essential prerequisite in all children irrespective of their HIV status. Whether these supplementation study findings would be applicable to HIV-infected adults with diarrhoea in varying stages of HIV infection is not clear. Iron supplementation has been reported to have adverse effects (due to oxidative stress?) on the course of HIV infection, perhaps in settings wherein iron deficiency is not a problem. The applicability of the finding to countries with widespread iron deficiency and

anaemia is limited. Iron deficiency and anaemia are associated with immune-depression; so far there have been no reports on the whether of detection and treatment of anaemia has any positive impact on the course and outcome of HIV disease.

### **HIV infection in pregnancy and lactation**

Initial reports, mainly from sub-Saharan countries, suggested that HIV-infected pregnant women gain less weight and experience micronutrient deficiencies more frequently than uninfected pregnant women. However, when comparisons were made between pregnant women with similar socioeconomic status, there were no significant differences in weight gain, mid-upper arm circumference, and triceps fat fold thickness between asymptomatic pregnant women at early stages of HIV infection and HIV-negative women. A high proportion of HIV-positive women had anaemia along with low or deficient folate or vitamin A levels. This could be because HIV-positive mothers in developing countries may not be consuming a balanced diet rich in micronutrients, and may not be receiving prenatal vitamin and mineral supplements. There are no differences in the extent of weight loss between HIV-positive lactating women and HIV-negative lactating women<sup>13</sup>.

Most studies have reported that undernourished HIV-positive pregnant women had higher viral loads and lower CD4+ counts. Some studies have documented that a higher proportion of HIV-positive pregnant women who had low or deficient levels of folate, albumin, and vitamin A, had increased viral loads and decreased CD4+ counts. Optimal nutrition for HIV-infected women during pregnancy and lactation increases weight gain and improves pregnancy and birth outcomes. Pregnancy and lactation do not hasten the progression of HIV infection<sup>13</sup>.

The major concern in pregnancy is to prevent mother-to-child transmission of HIV infection. Transmission during delivery is most common, accounting for 60-85% of transmissions of the virus from the mother to her baby. Prevention of mother to child transmission of HIV infection underwent dramatic improvement with availability and improved access to anti-retroviral drugs. Counselling and screening of pregnant women for HIV infection and

providing antiretroviral drugs to seropositive women have become an essential component of antenatal care. In line with global efforts, India also has scaled up its efforts to prevent mother-to-child transmission of HIV. UNAIDS has set the goal of reducing maternal mortality by half and eliminating new infections through mother-to-child transmission by the year 2015<sup>2</sup>.

### **HIV infection and child nutrition**

The global estimates reported by UNAIDS for the year 2010 indicate that there were ~3.4 million HIV-infected children, of which ~390,000 were newly infected during the year<sup>1</sup>. HIV infection can be transmitted from mother to child during breast feeding. In the mid-1980s the guidelines from the WHO and the Centre for Disease Control (CDC), USA suggested that, in order to prevent HIV infection transmission through breast milk, sero-positive women should not breast feed their offspring. This was an appropriate recommendation for developed countries where formula feeds are generally affordable, accessible and safe, and where the majority of babies were in any case receiving formula feeds. However, these guidelines may not be suitable for developing countries.

In India the first known occasion of the birth of an infant to a sero-positive mother was in 1987. In tune with the WHO guidelines, all new mothers who were known to be sero-positive for HIV were counseled not to breast-feed and provided with infant milk formulae soon after delivery so that cost would not become a barrier. The mothers were counselled on how to prepare the formula and feed their infants. The mother-child dyads were followed up closely. Within a year it became obvious that, despite these measures many of the infants were experiencing repeated infections and were showing severe growth faltering by the age of 6 months. Similar findings were reported from other developing countries. The ICMR expert group weighed the risk of improper formula feeding against that of transmission of the virus through breast milk, recommended that breast feeding, which is known to protect against morbidity and undernutrition, should be promoted in infants irrespective of whether they were born to sero-positive women or to those whose HIV infection status was not known because they had not been screened for HIV<sup>14</sup>. India successfully spearheaded efforts to call

for modification of the WHO guidelines from the perspective of developing countries. India's efforts to ensure that breast feeding was established as the norm for all mothers irrespective of their HIV status (known or unknown) has saved the lives of many infants and prevented deterioration in their nutritional status, in India as well as in other developing countries.

ART is effective in preventing HIV transmission during pregnancy and delivery but is not very effective in preventing transmission through breast milk. Therefore, countries will have to adhere to the guidelines that are the most appropriate for them, balancing the risk of HIV transmission through breast milk against the risk of morbidity and undernutrition through improper formula feeding practices. Recognising this reality, the WHO infant feeding guideline<sup>15</sup> (2010) states: "Infant feeding practices recommended to mothers known to be HIV-infected should support the greatest likelihood of HIV-free survival of their children and not harm the health of the mothers. To achieve this, prioritization of prevention of HIV transmission needs to be balanced with meeting the nutritional requirements and protection of infants against non-HIV morbidity and mortality. Every effort should be made to accelerate access to antiretrovirals (ARVs) for both maternal health and also prevention of HIV transmission to infants. While ARV interventions are being scaled up, national authorities should not be deterred from recommending that for HIV-infected mothers, breastfeeding is the most appropriate infant feeding practice in their setting. Even when ARVs are not available, mothers should be counselled to exclusively breastfeed in the first six months of life and continue breastfeeding thereafter unless environmental and social circumstances are safe for, and supportive of, replacement feeding. In circumstances where ARVs are unlikely to be available, such as acute emergencies, breastfeeding of HIV-exposed infants is also recommended to increase survival".

Undernutrition and growth faltering are common in HIV-infected children<sup>16,17</sup>, with a significant adverse effect on survival independent of the degree of immune deficiency. In countries like India, even among the "normal population", intrauterine growth retardation is common and one-third of infants are born with low birth weight. Intrauterine growth may be compromised to a greater

extent in children born to HIV-infected women. In developing countries, insufficient food intake and diarrhoea are two major factors contributing to poor growth and undernutrition, both in HIV-infected and HIV-negative children. Prevention, early detection and treatment of diarrhoeal illnesses may be effective interventions for enhancing childhood growth and survival in children with HIV. Undernutrition in HIV-infected children is associated with rapid progression of the disease and poor outcomes. The available data indicate that energy supplementation to HIV-infected children improves weight gain but does not reverse deficits in height.

Increased access to ART has made an enormous contribution towards improving the health status and survival of HIV-infected children. ART postpones progression in HIV infection, reduction in CD4 counts prevents deterioration in health and nutritional status and prolongs life. However, ART use is not without side-effects. The use of ART to suppress the viral load and improve immune status has been shown to adversely affect body weight and linear growth in children. Several abnormalities in body fat, lipids, insulin and bone metabolism have been identified in children receiving ART.

The following are some of priority areas requiring strengthening under HIV/AIDS programmes<sup>16</sup>:

- Measurement of length or height in addition to weight in all infants and children as part of the nutritional monitoring of HIV-infected infants and children, to identify those in need of intervention.
- Nutrition training and education programmes for health services personnel involved in the care of HIV-infected children.
- Foregrounding nutrition as a component of health education for caregivers of HIV-infected children.
- Early detection and management of illnesses, especially diarrhoea, among children infected with HIV.
- Targeting children with suboptimal growth for assessment and treatment of potentially reversible growth failure.
- Adapting algorithms for assessment and management of

HIV-infected children with poor growth.

### Summary and Conclusions

1. There are major differences in the nutrition profiles of HIV-infected persons depending upon the country where they live their economic status, route of infection, response to the virus, stage of the disease at the time of detection, type of opportunistic infections present, access to antiretroviral treatment, essential healthcare and nutrition services. All these and their interactions account for the reported wide variation in the interactions between HIV infection and nutrition as well as impact of interventions.
2. Irrespective of factors responsible, undernutrition hastens reduction in CD4 counts and rapidity of disease progression, increases susceptibility to infections, leads to poor response to ART, and poor clinical outcomes. Adequate dietary intake and nutrition is essential to obtain optimal benefits from ART.
3. Many of HIV infected persons find it difficult to obtain gainful employment, adversely affecting their food security and nutritional status; for them food is the first and most important medicine. Undernutrition and micronutrient deficiencies are common in HIV infection. Efforts should be made to ensure macro and micronutrient intake at recommended levels in HIV-infected persons, both adults and children, through consumption of diversified diets.
4. Opportunistic infections are associated with rapid weight loss in HIV infected persons and require effective treatment. Tuberculosis is a common co-infection in HIV-infected persons; effective treatment of tuberculosis reverses weight loss. Development and assessment of nutritional supplements for managing weight loss in those with severe opportunistic infections and persistent diarrhoea should receive due attention.

5. The data regarding the benefits of macro or micronutrient nutritional supplementation are inconclusive and sometimes contradictory. Research focus should be on determining the types of patients who are most likely to benefit and type of food supplements that are the most appropriate for them. Impact of focused macronutrient supplementation in undernourished persons and treatment of anaemia in anaemic HIV infected persons have to be investigated on priority basis.
6. There are reports from both developed and developing countries that some HIV-infected persons on long term ART tend to become obese and develop metabolic syndrome. Although the benefits of antiretroviral therapy far outweighs the risks, and appropriate intervention have to be initiated in those with metabolic syndrome to reduce the risk of non communicable diseases in HIV-infected persons on ART.
7. Knowledge of HIV status is important for making informed decisions with regard to reproductive health, infant / child feeding and child rearing.
8. Pregnancy and lactation do not hasten the progression of HIV infection. Ensuring optimal nutrition of HIV-infected women during pregnancy and lactation leads to appropriate weight gain and optimal pregnancy outcomes. HIV-infected pregnant women in developing countries gain less weight during pregnancy and are more likely to have micronutrient deficiencies than uninfected pregnant women. Efforts should be made to correct undernutrition and micronutrient deficiencies (especially anaemia) in these women.
9. Currently ART coverage in pregnant women is improving rapidly and with focussed interventions it should be possible to achieve the goal of zero new infections from mother to child transmission by 2015.

10. There is a risk of transmission of HIV through breast milk; the risk is greatest among women newly infected or with advanced HIV disease. In developing countries, the risk of HIV infection transmission through breast milk has to be assessed against the risks of repeated morbidity and under nutrition associated with improper / unhygienic formula feeding. Current recommendation is that under these circumstances mothers from low income groups who are HIV-positive and those whose HIV status is unknown should exclusively breastfeed the infant for the first 6 months, followed by safe and appropriate complementary feeding along with continued breastfeeding for 24 months and beyond.
11. Children are a very vulnerable section of the population. Undernutrition and poor growth are associated with increased risk of morbidity and mortality in HIV infected children. Growth faltering is often observed even before the onset of symptomatic HIV infection. Improved dietary intake enables these children to regain lost weight after an opportunistic infection has been treated. The growth and survival of HIV-infected children are improved by prophylactic use of cotrimoxazole, antiretroviral therapy, prevention, early detection and treatment of opportunistic infections.
12. Globally, HIV epidemic has plateaued, new infection rates are coming down but HIV infection continues to be a major public health problem with inter-generational effects. Access to ART has improved nutrition, health status and longevity of HIV infected persons. As nutritional status is a major determinant of course and outcome of the HIV infection, nutritional interventions can be useful adjuvants to ART and can play very major role in improving quality of life of the individuals.

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## FOUNDATION NEWS

- Annual Foundation Day and C. Ramachandran Memorial Lecture The Annual Foundation Day of NFI will be celebrated on 22nd November 2012. On the occasion, Dr B. Sesikeran (Director, National Institute of Nutrition, Hyderabad) will deliver the C. Ramachandran Memorial Lecture.

- **Study Circle Lecture**

On 12th September 2012 Dr. N. K. Arora (Executive Director, The INCLEN Trust International, New Delhi) delivered a lecture on: "Non-alcoholic fatty liver disease in children – epidemiology and public health implications".

- **Workshop**

An orientation workshop on utility of pictorial charts showing "how to do" for effective use of mother child protection card was organised by Nutrition Foundation of India in collaboration with the National Mission for Empowerment of Women (Ministry of Women & Child Development) on 28.8.2012. About 35 participants from NMEW, FNB, NIPCCD, Dept. of WCD Delhi, Delhi Health Mission, IGNOU and NFI attended the Workshop.