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INFECTIOUS DISEASE IMPLICATIONS OF SUBCLINICAL ZINC DEFICIENCY IN CHILDREN

Davidson Hamer [1, 2, 3]

Abstract. *Zinc deficiency is highly prevalent in many developing countries, including India. Inadequate dietary intake, especially if the diet is rich in phytates which impair zinc absorption, and increased metabolic losses in the setting of infection predispose children to subclinical zinc deficiency. Compromised immune function, increased rates of serious infectious diseases, and impaired growth are potential consequences of zinc deficiency.*

The efficacy of zinc supplementation has been clearly demonstrated for improving growth and reducing the risk of developing diarrhoeal disease, pneumonia, and, possibly malaria in young children. In addition, zinc supplementation reduces the duration of acute or persistent diarrhoea. Limited recent evidence also suggests that zinc may be a useful adjunct to the treatment of pneumonia in young children. In contrast, zinc is not effective in the treatment of malaria. Given the efficacy of zinc for the prevention of serious infections and improving growth in young children, there is a need for broader programmatic implementation of this simple, inexpensive intervention.

INTRODUCTION

Zinc is an essential trace element, required for the normal growth and development of children. Depending on the extent of the deficit, deficiency of zinc may have many adverse consequences including growth retardation, hypogonadism, and impaired cell mediated immunity.[1] Mild zinc deficiency, though often asymptomatic, may be characterized by impaired immune function, memory impairment, decreased spermatogenesis in men, and impaired taste and smell.[2,3] In contrast, severe zinc deficiency is manifested by severely depressed immune function, growth impairment, recurrent infections, alopecia, dermatitis, diarrhoea, and lethargy. These findings are most commonly encountered in acrodermatitis enteropathica, a genetic disorder of zinc absorption, which is associated with severe zinc deficiency, immunological defects and increased susceptibility to infection.[4] In this condition, oral zinc supplements normalize immune function and dramatically reduce infectious disease morbidity and mortality. Zinc supplementation has also produced significant increases in weight and height in children, especially in those who were malnourished at baseline.[5]

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DIETARY ZINC DEFICIENCY

Dietary zinc deficiency is highly prevalent world-wide with an estimated two billion people affected.[6] Depressed immunity resulting from subclinical zinc deficiency increases the susceptibility of children to diarrhoeal disease, acute respiratory infection (ARI), and malaria. In fact, zinc deficiency is estimated to be responsible for approximately 18% of malaria, 16% of acute lower respiratory tract infections (ALRI), and 10% of diarrhoeal disease while contributing to nearly a million deaths world-wide each year.[7] A substantial proportion of the morbidity and mortality associated with zinc deficiency occurs in the South East Asian Region, especially South Asia.

Although many staple foods in resource-poor countries contain adequate amounts of zinc, compromised zinc status is nevertheless common.[8] Zinc deficiency usually results from the inadequate dietary intake of zinc, but can also develop in populations consuming high phytate diets. Inositol hexaphosphates and pentaphosphates (phytates) bind zinc and form poorly soluble complexes that lead to reduced zinc absorption.[9] Plant products, especially legumes and grains, have high concentrations of phytates. Increasing amounts of protein in the diet, especially animal protein, help to counteract the inhibitory effect of phytates on zinc absorption.[10] As a consequence of the high phytate content of the staples of the Indian diet: rice, wheat, and lentils, a substantial proportion of the population is at risk for zinc deficiency.

In addition to factors that decrease the bioavailability of zinc, inadequate intake of zinc due to undernutrition puts children and adults at risk for zinc deficiency. Further aggravating the situation is the risk of greater faecal and urinary excretion of zinc in the setting of infections, especially diarrhoea. Given widespread evidence of the prevalence of nutritional disorders in children and adolescents in peri-urban and tribal areas of Madhya Pradesh[11,12] and the widespread prevalence of diarrhoea, subclinical zinc deficiency is likely to be very common.

DIAGNOSIS OF SUBCLINICAL ZINC DEFICIENCY

Accurate assessment of zinc status is difficult and ideally should involve the use of multiple measures.[13] However, many of the more sophisticated measures of zinc status, such as platelet, lymphocyte, or tissue zinc, are not practical for large, field studies in developing countries. In addition, these measures have not been validated as markers of zinc status. While plasma zinc concentrations are commonly used as a surrogate marker of zinc status in many clinical trials, plasma zinc represents <0.2% of total body zinc stores and there is a poor correlation between plasma zinc concentrations and total body stores.[14] Similar to the situation with vitamin A, plasma zinc concentrations decline as part of the acute phase response to infections. This

has been clearly demonstrated in experimentally induced infections in both animals and humans, with more severe infections leading to a more significant decrease in zinc concentrations.[15]

Three community-based studies in pre-school and school-aged children in Guatemala, Peru, and Zimbabwe found that plasma zinc concentration was not significantly affected by common intercurrent infections such as diarrhoea and respiratory tract infection.[16] In contrast, a cross-sectional study of school-age children in Papua New Guinea demonstrated an inverse association between zinc status and *P. falciparum* malaria.[17] In a recent multi-country, randomised, placebo-controlled study of the effect of zinc as an adjunct to treatment of malaria in pre-school children, zinc levels were low in all participants at baseline. However, with malaria treatment, zinc levels rose significantly in all participants, with those who received supplemental zinc showing significantly larger gains.[18] Therapy of malaria was thus associated with a rise in zinc levels, even in the absence of zinc supplementation. Multivariable analysis of predictors in this study showed that parasite density, admission C-reactive protein (CRP) level, and study site were the most important predictors of admission plasma zinc.[19] Similarly among children in Nepal presenting with acute diarrhoea, plasma zinc was lower in children with dysentery, fever, and elevated CRP concentrations.[20]

Based on these data, it appears that plasma zinc concentrations are transiently reduced during an acute episode of malaria or other severe infection, presumably as part of the acute phase response to infection, and that treatment of the disease and supplementation with zinc are independently associated with an increase in plasma zinc levels over time. Nevertheless, children with acute infections and low plasma zinc concentrations may still be at risk of zinc deficiency, and ascribing this depression solely to the acute phase response seems unwarranted. Low plasma zinc levels should thus be interpreted with concurrent measures of the acute phase response such as CRP, when available, especially among children with moderate to severe infectious illnesses. In children whose age, diet and/or nutritional status place them at risk of zinc deficiency, those with low plasma zinc levels should be supplemented with oral zinc. Despite these provisos about the limitations of plasma zinc as an indicator of zinc status in individuals, at a population level this measurement nevertheless remains a useful tool for field studies given the ease with which samples can be obtained and analysed.

SUBCLINICAL ZINC DEFICIENCY AND RISK OF INFECTION

A prospective study of children aged 12 to 59 months who had suffered from an episode of acute non-dysenteric diarrhoea at least 10 days earlier was carried out in an urban slum in New

Delhi.[21] Thirty two percent of children had low plasma zinc concentrations (≤ 8.4 µmol/L). Children with low baseline plasma zinc levels had a 47% higher risk of diarrhoea during the three-month observation period than those with normal zinc. Although the overall risk of ALRI was not significantly higher in the low plasma zinc group, boys with low plasma zinc had a four-fold higher risk of ALRI. The prevalence of ALRI was about three-fold higher in zinc-deficient children, possibly as a result of longer duration episodes of ALRI in this group.

PREVENTION OF COMMON CHILDHOOD INFECTIONS WITH ZINC SUPPLEMENTS

Numerous studies in recent years have found that zinc supplementation in children normalises immune function and dramatically reduce infectious disease morbidity and mortality.[22-25] A pooled analysis of studies of zinc supplementation for the prevention of diarrhoea and pneumonia (ALRI) in children in developing countries found that, in trials that provided 1-2 times the recommended daily allowance (RDA) of elemental zinc 5 to 7 times per week, the pooled odds ratios (OR) for diarrhoeal incidence and prevalence were 0.82 (95% CI 0.72 to 0.93) and 0.75 (95% CI 0.63 to 0.88), respectively.[26] The OR for pneumonia was 0.59 (95% CI 0.41 to 0.83) for zinc-supplemented children. Similar effects on the incidence of diarrhoea and pneumonia were also seen with short-course trials of zinc supplementation. This pooled analysis found a 33% reduction in the incidence of persistent diarrhoea but this effect only trended towards significance (OR 0.67, 95% CI 0.42 to 1.06). Similarly, zinc supplementation was associated with a non-significant reduction of dysentery of 13%. A more recent study of zinc supplementation given for a period of 14 days each time a child had an episode of diarrhoea demonstrated reductions in the duration and incidence of diarrhoea and a reduced incidence of ARI.[27] The non-injury death rate was also 51% lower in the zinc intervention clusters, suggesting that zinc supplementation reduced mortality.

In contrast to the extensive evidence base for the efficacy of zinc in the prevention of diarrheal disease and ALRI in children in resource-poor settings, relatively limited data is available for zinc and malaria. A zinc supplementation trial in The Gambia, designed principally to measure the effect of zinc on growth, found that the zinc supplementation was associated with a 32% reduction in health centre visits for slide-confirmed malaria, though this difference did not attain statistical significance.[28] While this finding was provocative, the study was not optimally designed for this outcome, and had several important limitations including small sample size, a twice-weekly zinc dosing regimen, and no precise definition of malarial illness. Subsequent work from Papua New Guinea was more convincing. In a community-based study, a 46-week

period of zinc supplementation in preschool children significantly reduced *P. falciparum*-attributable health centre attendance by 38% (p=0.037).[29] Episodes accompanied by any level of parasitemia were also reduced by 38% (p=0.028) and episodes with parasitemia ≥100,000 per µL were reduced by 69% (p=0.009).

A community-based trial of zinc supplementation in Burkina Faso on the incidence of febrile episodes of falciparum malaria, the severity of malaria episodes, or anaemia in children aged 6 to 31 months demonstrated that the cross-sectional prevalence of falciparum malaria and of *P. falciparum*, *P. malariae*, and *P. ovale* parasitemia were all significantly lower in children supplemented with zinc (p=0.001 for all comparisons to placebo).[30] In addition, the mean density of *P. falciparum* increased significantly (p=0.001) during the study in the placebo group relative to the zinc group. Thus, zinc supplementation appeared to provide benefits in terms of several key malariometric measures. Other beneficial effects of zinc supplementation, such as a significant reduction of the number of days with diarrhoea (p = 0.002) and a trend towards reduced mortality (RR 0.41, 95%CI 0.15-1.19, p = 0.1) were also noted. In contrast, this study failed to find any benefit of zinc on the incidence of clinical malaria episodes. There are several potential explanations for the lack of a protective effect of zinc for malaria in this study. First, the sample size was too small to measure this effect, since the proportion of febrile malaria episodes of all children with positive blood smears was quite small. Second, the prevalence of clinical zinc deficiency in the population under study was low. Using a cut-off point for zinc deficiency of 60 µg/dL[26], only a small proportion of these children were zinc deficient at baseline, as the mean zinc concentration was 76.5 µg/dL. Theoretically, zinc might have a greater effect on clinical malaria if used in a population where zinc deficiency was widespread.

Thus, in summary the evidence is strong that zinc supplementation serves to protect children against diarrheal disease, ALRI, and potentially malaria. In addition, there is growing evidence that zinc supplementation may reduce mortality in young children.[27,30,31] Zinc also appears to be effective as an adjunct to the treatment of serious infections in young children.

ROLE OF ZINC SUPPLEMENTATION IN TREATMENT OF COMMON CHILD-HOOD INFECTIONS

Zinc supplementation, as an adjunct to oral rehydration therapy, reduced the duration and severity of acute and persistent diarrhoea in several randomized controlled trials.[24,32-36] A pooled analysis of randomized, controlled trials of zinc for acute diarrhoea found that zinc reduced the mean duration of diarrhoea by 16% (95% CI: 7%, 26%).[37] Zinc-supplemented children also had a 15%

lower probability of continuing diarrhoea on a given day in the acute diarrhoea studies and a 24% lower probability of continuing diarrhoea in the persistent diarrhoea trials. There was also a 42% lower rate of death or treatment failure in the persistent diarrhoea studies. An analysis of the cost-effectiveness of zinc as adjunct therapy to standard management of acute childhood diarrhoea, including dysentery, found that the use of zinc significantly improved the cost-effectiveness of standard treatment for both dysenteric and non-dysenteric diarrhoea.[38]

Two studies evaluated the efficacy of zinc as an adjunct to antimicrobial therapy for children with severe ALRI.[39,40] In the first study, children aged 2-23 months with severe pneumonia received 20 mg of zinc per day plus standard antibiotics until hospital discharge.[39] Children who received zinc had reduced duration of severe pneumonia including shorter duration of tachypnea, hypoxia, and chest in-drawing. The overall duration of pneumonia was 4 days in children treated with zinc versus 5 days in those who received placebo. The second study involved the administration of 10 mg of zinc twice daily for 5 days to children aged 2-24 months with severe ALRI.[40] Zinc treatment significantly reduced the duration of fever and very ill clinical status as judged by the study paediatrician in boys but not girls. Since this finding arose from post hoc subgroup analysis, it needs to be validated in a gender-stratified, randomized controlled trial. These two studies provide early suggestions of a potential therapeutic effect of zinc for severe pneumonia in very young children. Whether zinc will prove to be a useful therapeutic adjunct for the treatment of pneumonia in older children or for selected respiratory pathogens remain open questions

The utility of zinc supplementation for the treatment of measles was evaluated in only one study.[41] Children aged 9 months to 15 years who were hospitalized in India for measles were randomized to zinc or placebo in addition to routine supportive care. Treatment with zinc had no impact on the time to recovery or the proportion of children who were judged to be cured by day six.

In order to evaluate the potential role of zinc as an adjunct in the treatment of acute, uncomplicated falciparum malaria, a randomized, placebo-controlled, multi-centre trial was undertaken.[18] Children (n = 1087) between the ages of 6 months and 5 years with fever and ≥2,000/μL asexual forms of *P. falciparum* in a thick blood smear were enrolled at sites in Ecuador, Ghana, Tanzania, Uganda, and Zambia. Children were randomized to receive zinc (20 mg/d for infants, 40 mg/d for older children) or placebo for four days as well as chloroquine, the standard first line treatment for malaria in all sites at the time of study initiation. There was no effect of zinc on the median time to reduction of fever (zinc = 24.2 h vs. placebo = 24.0 h, p= 0.37), reduction of parasitemia by >75% in the first 72 h

(zinc group = 73.4%; placebo group = 77.6%, p= 0.11), or hemoglobin concentration during the three day period of hospitalization or four week follow-up period. This carefully designed study thus failed to demonstrate any benefits of zinc as an adjunct to the treatment of malaria.

CONCLUSIONS

Subclinical zinc deficiency is highly prevalent in many developing countries as a result of inadequate dietary intake, impaired absorption secondary to high phytate content of grain-based diets, and increased faecal and urinary losses caused by infections. During the last two decades, there have been a large number of studies of zinc for the prevention and treatment of serious childhood infections.

The efficacy of zinc supplementation has been clearly demonstrated for improving growth and reducing the risk of diarrhoeal disease and pneumonia in young children. Zinc supplementation may also serve to prevent malaria. When used as a therapeutic adjunct, zinc supplementation helps to reduce the duration of acute and persistent diarrhoea. Limited recent evidence also suggests that zinc may be a useful adjunct to the treatment of pneumonia in young children. In contrast, zinc appears to offer no benefit as an adjunct to the treatment of malaria or measles. Given the body of evidence of the efficacy of zinc for the prevention of serious infections and improving growth in young children as well as limited evidence suggesting that zinc supplementation may reduce mortality, there is a need for broader programmatic implementation of this simple intervention.

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GEOMATICS AND ECOEPIDEMIOLOGY

R. Jaishanker[1] and C. P. Johnson[2]

Abstract. *Geomatics has transformed the way we describe and study the Earth. Together, Geographic Information System (GIS) and remote sensing have remarkable potential to address public health issues. In India, a lag exists in the routine applications of geomatics in health sector. Ecoepidemiological studies are significant in the backdrop of global climatic changes. This paper provides a comprehensive description of GIS and remote sensing from a public health perspective, lists some of the contemporary aerospace applications for epidemiology and concludes with a call for coherent multidisciplinary approach to reduce the prevailing technology-gap.*

INTRODUCTION

Geomatics or geographic-informatics is the synergy of multiple disciplines namely Geographic Information System (GIS), Remote Sensing (RS), Photogrammetry, Cartography and Geodesy. It is fundamental to all the disciplines, which use data identified by their location. GIS and remote sensing from aerospace platforms are sophisticated and powerful technologies that are finding applications far beyond those originally intended. Together, they allow near real-time access to spatial data on patterns of land use, phases of vegetation, temperature, soil, elevation, precise geographic location of water bodies, population centres, buildings, roads, and other infrastructures.

The advances in geographic information and mapping technology have created new opportunities for public health administrators to enhance their planning, management and monitoring capabilities. The technology can help planners better access and analyze the spatial relationships of factors and constraints in the implementation of public health programs. Ironically, public health professionals in India, who are in the best position to exploit geographic information and mapping technology, are less exposed to the technology. This is mainly due to lack of awareness of the potential of this technology, access to the technology and financial constraints.

Vector-borne diseases involve a causative agent (pathogen), usually a microorganism that causes the disease in the host. Disease vectors help in the dissemination of the causative agent. Most disease vectors belong to the phylum Arthropoda. Transmission cycles of certain vector borne diseases

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also include intermediate and reservoir hosts. Arthropods are very adaptive and ecologically diverse phylum. They have successfully adapted and evolved into virtually every environment on Earth.

The Earth is being subjected to many human-induced and natural changes, which are transforming global ecological systems. The transformations manifest mainly as change in land cover, land use and climate. Many of these factors have been suggested as explanations for resurgence of infectious diseases[1].

'Eco-epidemiology' is emerging in response to a perceived need to broaden the scope of assessment of the impact of environmental changes[2]. This entails a shift in emphasis from a direct study of an individual to an indirect study of a region. Vector and host surveillance and study of the ecology of infectious diseases are essential components of any public health program. Ecological studies are also significant because they may give insight into factors that affect spatial (of space) as well as temporal (of time) cycles of infectious diseases[3]. In addition to the ecological determinants of vector-borne diseases, climate change also influences the worldwide spread of diseases. Climatologists predict a 2^0C rise in global temperatures by the end of 21st century[4]. This is expected to directly affect vector-borne diseases by expanding the geographical range, increased reproduction and decreasing incubation period of the pathogen.

Emerging and re-emerging vector-borne diseases are a challenge that requires a new proactive pragmatic response from the public health professionals. Geomatics technology is ideally suited for renewed efforts to tackle the problem of vector-borne disease at different spatial scales.

GEOGRAPHIC INFORMATION SYSTEM

Many misconceptions exist as to the meaning of the term GIS, particularly in disciplines where the use of such technology has not yet been firmly established. The phrase 'geographic information system' was first used in the 1960s to refer to a computerized system for asking questions of maps showing current and potential land use in Canada[5]. A GIS can be defined as a *'set of tools for collecting, storing, retrieving, transforming and displaying spatial data from the real world for a particular set of purposes'*[6]. A typical GIS comprises an organized collection of computer hardware, software, geographic data and personnel, designed to efficiently capture, store, update, analyze and display all forms of geographically referenced information. Each piece of information is related in the system through specific geographic coordinates to a geographical entity (e.g. health centre, school, dam, drainage, village or state). The information can be displayed in the form of maps, graphs, charts and tables. GIS adds the dimension of geographic analysis to information technology by providing an

interface between data and map. This makes it easy to present information to decision-makers quickly, efficiently and effectively. The technology provides tools for visualizing, integrating, and analyzing spatial data with a unique capability to merge information from multiple sources. By using a common spatial framework, GIS enables the users to analyze how the various physical, social, economic and ecological factors interact.

GIS has several advantages over conventional methods used in health planning, management and research.

Data management: GIS provides the user, the ability to store, integrate, query, display, and analyze data from the molecular level to that of satellite resolution through their shared spatial components obtained from diverse sources. Surveillance of diseases requires continuous and systematic collection and analysis of data. GIS can eliminate the duplication of effort involved in data collection across an organization, and hence substantially reduce the cost involved. It can also serve as a common platform for convergence of multi-disease surveillance activities.

Global positioning systems (GPS) can be used to obtain locations of point features on a map, such as wells or septic tanks, precisely. GIS can process aerial or satellite imageries to allow information such as temperature, soil types and land use to be easily integrated, and spatial correlations between potential risk factors and the occurrence of diseases to be determined. Latest and accurate, maps are essential for epidemiological surveillance. GPS, high-resolution satellite imageries and aerial photographs can be used to obtain accurate and up-to-date maps of any region. Multi-temporal satellite imageries can be used to monitor land use and land cover changes over time.

Visualization: GIS offers powerful tools to present spatial information to the level of individual occurrence, and conduct predictive modeling. It determines geographical distribution and variation of diseases, and their prevalence and incidence. For example, in studying the surveillance of malaria in India, it is important to find out which type of malaria is occurring in which parts of the country. Such studies have important implications for the disease eradication strategy to be employed. GIS can help generate thematic maps - ranged color maps or proportional symbol maps to denote the intensity of a disease or a vector. In comparison with tables and charts, maps developed using GIS are more effective means for communicating messages clearly even to those who are not familiar with the technology. GIS keeps track of the geographical locations of service providers, customers, resources, and health plans and programs. It allows policy makers to easily understand and

visualize the problems in relation to the resources, and effectively target resources to those communities in need. GIS permits dynamic link between databases and maps so that data updates are automatically reflected on the maps.

Overlay analysis: GIS can overlay different pieces of information. This helps in decision-making and medical research through techniques like multi criteria modelling (for e.g. in understanding the association between prevalence of certain diseases and specific geographic features).

Buffer analysis: GIS can create buffer zones around selected features. For example, a radius of 10 km around a hospital to depict its catchment area or 1 km around an effluent discharge site or 50 m on both sides of sewerage to indicate the spread of hazardous material. The user can specify the size of the buffer and then combine this information with disease incidence data to determine how many cases fall within the buffer.

Network analysis: GIS provides the ability to quickly access the geo-demographic dynamics of an organizations existing service area in contrast to the likely demand for services at a new location. It can identify catchments areas of health centres and also locate suitable site for a new health facility. Health services delivered at home (e.g. polio vaccination) can be scheduled in a more efficient manner by analyzing transportation factors and street patterns, and by recommending the most efficient route. GIS Provides accurate and timely information about where health services are located, and instructions and maps on how to get there.

Statistical analysis: GIS can carry out specific calculations, for example, proportion of population falling within a certain radius of a health centre or dam. It can also calculate distances and areas, for example, distance of a community to a health centre, and area covered by a particular health program.

Query: GIS allows interactive queries to extract information contained within the map, table or graph. It can answer queries of location, condition, trends, spatial patterns and modeling.

Extrapolation: GIS provides a range of extrapolation techniques. For example, vector distribution in inaccessible and non-sampled areas can be mapped using GIS.

Web GIS : One of the recent advancements in GIS technology is web-based GIS. Health data is stored in a central server, which can be accessed from various terminals connected to the server through internet or intranet.

Internet based GIS technology eliminates the traditional method of flow of information, and the information is instantly available across the globe. Dynamic maps published on the web allow continuous monitoring for effective health interventions.

POTENTIAL APPLICATIONS OF GIS IN PUBLIC HEALTH

GIS is gradually being accepted and used by public health administrators and professionals, including policy makers, statisticians, epidemiologists, regional and district medical officers. Some of its potential applications in public health are listed below:

- Determine the geographical distribution and variation of diseases
- Analyze spatial and temporal trends of diseases
- Identify gaps in immunizations
- Map populations at risk and stratify risk factors
- Document community health care needs and assess resource allocations
- Forecast epidemics
- Plan and target interventions
- Monitor diseases and interventions over time
- Manage patient care environments, materials, supplies and human resources
- Monitor the utilization of health centres
- Route health workers, equipments and supplies to service locations
- Publish health information using maps on the Internet
- Locate the nearest health facility.

REMOTE SENSING

Remote sensing has been defined as: "the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in direct contact with it"[7]. The 'science' of remote sensing rests on the fact that every object, area, or phenomenon reflects and emits energy at specific and distinctive wavelengths of the electromagnetic spectrum. Acquisition of remote sensing data for environmental monitoring is generally restricted to the visible, infrared, and microwave regions of the spectrum. The "art" of remote sensing lies in the ability to exploit this basic matter and energy relationship, in order to identify, map, or monitor features of interest.

Several characteristics of remote sensing data make them especially well suited for studying environmental processes: (1) imagery acquired from aircraft or satellite platforms provides a synoptic view of the Earth's surface; (2) sensors can be calibrated to record in spectral regions beyond those to which the human eye is sensitive; (3) data are commonly available in digital format for computer analysis and integration with other digital databases; and (4) they provide a historical record of conditions for a particular area or region.

In order to understand how remote sensing data can be applied in disease vector surveillance, it is necessary to

review a few basic principles. The digital image generated by multi spectral scanner system is actually a two-dimensional array of discrete picture elements, or pixels. The sensors for each array are calibrated to record reflected and/or emitted energy in a specific spectral region. Individual pixels in this array may be from a few meters to several kilometers. The value (digital number, DN) of each pixel, which corresponds to photographic gray level, represents the average reflectance over the ground area being measured.

The interpretation of aerial photography, or enhanced multi spectral imagery that has been photographically processed, involves the visual identification of objects and the determination of their meaning or significance based on color, shape, size, shadow, tone, texture, pattern, location and association. In contrast, analysis of digital multi spectral scanner data requires both computer processing and human interpretation of the results of the processing. The promise of remote sensing technology is to allow the user to extrapolate local-level measurements to a regional scale and therefore to discern spatial and temporal patterns that could otherwise not be seen.

Selecting the appropriate remote sensing data for a given study requires consideration of the spatial, spectral, and temporal resolution of the data and the phenomenon being studied. It is important to determine if the data are being acquired (a) at an appropriate spatial scale, (b) in spectral regions that will allow features of interest to be distinguished from their surroundings, and (c) at appropriate times of the year to achieve the goals of the study.

Complex sets of inter-relationships exist between remotely sensed imagery of the land surface and disease risk distributed spatially on that land surface. Since the amount of radiation reflected (at a given wavelength) from a given point on the Earth's surface depends on the nature of land cover type at that point, it is possible to predict the land cover spatially from remotely sensed imagery. The spatial prediction of land cover is based on explicit physical processes. Similarly, the links between other environmental variables that have been employed in the remote sensing of disease risk (e.g., cold cloud duration, CCD) and remotely sensed imagery are based on physical processes.

The link between land cover and vector density (or disease risk) is based on processes that are less easily described in terms of the physics of the processes involved, but which may be described well by stochastic models.

ECOEPIDEMIOLOGICAL APPLICATIONS OF REMOTE SENSING DATA

The idea that place and location can influence health is an old concept. As far back as the time of Hippocrates (460-

370 BC), physicians had observed that certain diseases seem to occur in some places and not in others. First expressed by the Russian epidemiologist Pavlovsky[8], the underlying concept of landscape epidemiology is that by knowing the environmental conditions necessary for the maintenance of specific pathogens in nature, one can use landscape analysis to identify the spatial and temporal pattern of disease-risk distribution. Environmental elements, including elevation, temperature, rainfall, and humidity, influence the presence, development, activity, and longevity of pathogens, vectors, zoonotic reservoirs of infection, and their interactions with humans[9]. Vegetation type and distribution are also influenced by the environmental variables mentioned above, and can be expressed as landscape elements that can be remotely sensed and whose relationships can be modeled spatially.

Though not in the strict sense of a GIS, the use of mapping to solve public health and epidemiological problems dates back more than a century when epidemiologist John Snow employed the basic mapping concepts in 1854 to determine the cause of *Soho* cholera outbreak[10]. The use of aerial photography and manual interpretation techniques to identify and map disease vector habitats can be traced to 1949[11]. Visual photographic interpretation techniques that exploit tone and texture have been used to identify and map landscape units associated with tick-borne encephalitis and tularemia in parts of the former Soviet Union[12].

One of the first uses of multi-spectral scanner data was in the early 1970s when investigators from National Aeronautics and Space Administrations (NASA) and Mexico developed a remote sensing approach for monitoring environmental parameters required for the propagation of the screwworm fly[13]. A number of studies have established the potential of remote sensing for detection of vector borne diseases (Table1). Studies on the use of remote sensed data to identify vector (mosquito) breeding sites have also been carried out in India. The findings of the studies cited in Table1 illustrate how geospatial technologies can provide scientists with a new perspective with which to study the factors influencing the patterns of vector-borne diseases at a variety of landscape levels. The diverse potential of remote sensing applications in vector surveillance and control programs is brought out in a special issue of the proceedings of the 1990 International conference on Applications of Remote Sensing to Epidemiology and Parasitology[14].

Successful application of remote sensing technology depends on the ability to: (1) extrapolate measurements made at a local level to a regional or global scale; (2) formulate and test new

research hypotheses; and (3) develop "near-real time" models to predict the spatial and temporal patterns of vector populations and disease transmission risk. Processes that operate at a variety of landscape scales influence the dynamics of vector-borne disease at any point. Malaria, for example, can be viewed as local as well as global problem. Remote sensing imagery (from high-resolution aerial photography to coarse-resolution satellite imagery) when combined with GIS spatial analyses techniques can play an important role in existing and future vector surveillance and control programs at local and regional scales.

CONCLUSIONS

The potential opportunities offered by the use of remote sensing to measure associations between environment and human disease were outlined as early as 1970[15]. Despite many clarion calls during the intervening years and the results of many more studies, the public health community is yet to realize the full potential offered by Geomatics technology for vector surveillance and control. Isolated independent studies that are presently reported, no doubt, generate new knowledge. However, such spatially and temporally intermittent knowledge has limited utility in addressing societal problems. This is best illustrated by the geospatial disease surveillance system in place in Dindigul, Tamil Nadu. The system is bound by the geographical limits of Dindigul municipality, whereas the causative organisms, the vectors nor the affected individuals are. This severely restricts the effective large-scale utility of such isolated attempts.

The 'technology-gap' between public health workers and geomatics professionals limits the effective utilization of geospatial technology to address community health concerns. Technological change continues to drive the evolution of geomatics thereby continuously widening the gap. This has serious implications for the successful application of geospatial technologies for public health. Geomatics will play an important and expanding role in our societies, and public health officials have the responsibility to ensure that the promise of this technology is well realized. Coherent efforts between administrators, practitioners in public health agencies and researchers in scientific organizations will help utilize the untapped potential of geomatics technologies for addressing public health problems.

Table 1: Remote-sensing applications for disease / vector surveillance - A compilation of selected studies.

Remote sensing data used	Parameter derived from remote sensed data	Disease/ vector	Reference
Landsat TM	Land cover	African tick	Hugh-Jones[16]
Color infrared Aerial photography	Land and water cover	Mosquito	Welch *et al.* [17]
TM Simulator/ Landsat TM	Water and Vegetation cover	Mosquito larvae	Wood *et al.*[18]
Airborne SAR/ Landsat TM	Topography	Rift valley fever virus/ Mosquito Dambos in river valleys	Pope *et al.*[19]
AVHRR NDVI (1.1km)	Vegetation amount	Trypanosomiasis/ Tsetse fly & Ticks	Rogers and Randolf [20]
Landsat TM	Land cover	Malaria/Mosquito	Beck *et al.* [21]
Landsat TM	Vegetation amount	Guinea worm/ Water flea	Ahearn and DeRooy [22]
SPOT HRV	Vegetation amount	Malaria/Mosquito	Roberts *et al.* [23]
AVHRR NDVI, Temperature	Vegetation amount	Trypanosomiasis/ Tsetse fly	Rogers *et al.*[24]
AVHRR NDVI (1.1km)	Vegetation amount	Trypanosomiasis/ Tsetse	Robinson *et al.*[25]
AVHRR NDVI, (8km) Temperature, MIR	Vegetation amount	Malaria/Mosquito	Hay *et al.*[26]
AVHRR NDVI (1.1km)	Vegetation amount	Malaria/Mosquito	Thomson *et al*.[27]
IRS 1A & 1B	Vegetation/ Ecotype	Malaria/Mosquito	Sharma *et al.*[28]
IRS 1D	Eco-epidemiological classes	Malaria/Mosquito	Srivastava *et al*.[3]

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CONCERN FOR POSTNATAL CARE SERVICES- USUALLY A LESSER VALUED SERVICE IN RURAL AREAS (A study among the primitive Lodha tribe of West Bengal)

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Abstract. *The study is a small attempt to understand the utilization of the postnatal care services among 500 ever-married Lodha women in the reproductive age group in Medinipore district of West Bengal. About 47% (230 Nos.) of the respondents stated to have received some form of postnatal care within the post-partum period of six months following their last delivery, which is higher than antenatal services availed by these respondents (43%). Among these 230 women, the actual postnatal care services received at Government health posts is only 32% and the remaining received some form of care either from family members, midwife, local medicine man or paramedical at private health dispensaries.*

INTRODUCTION

There is a general agreement that the health status of the tribal population in India is very poor. Different studies have tried to establish this with the help of morbidity, mortality and health statistics.[1-11] The tribal populations have distinct problems, not because they have special kind of health, but because of special placement in difficult areas and the circumstances in which they live. Like antenatal care services, post-natal care services are also equally important for the mother and the child especially from the viewpoint of growth, monitoring and immunizing. There is a general feeling among the rural women that once the child is born there is no need for any checkup either for the mother or for the child except in case of serious problem.[12] Routine post-natal care is not readily available in many developing country settings and thus there is still fairly limited survey experience of these studies.[13] Further, such studies among the tribal communities are very few. This prompted us to undertake this study among the Lodha, one of the primitive tribe of West Bengal and attempt was made to look into the level and source from which the postnatal care was delivered. The study also highlighted certain indicators for improving the utilization of services among the tribe.

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MATERIAL AND METHODS

The survey was carried out during 1997 among Lodha women in the reproductive age group. The study pertains to the tribe Lodhas of West Bengal who are overwhelmingly conglomerated in the Medinipore district of the state.[14-20] Hence the survey is restricted to Medinipore district (Fig.1). In the absence of any reliable population information of the tribe the latest records available with the Tribal Welfare Department, Office of the District Magistrate, Medinipore, the total Lodha population in the district was recorded as 36,069 in 1990. A sample of 500 ever - married Lodha women in the age group 15-49 years was drawn from 6 blocks of the district proportionally to its size. The 6 blocks were selected randomly and together it constitutes about 60% of the total Lodha female population of the district. Villages predominated by Lodha were identified and listed. A sub sample of randomly selected 20 women per household per village was interviewed by canvassing a pre-designed interview schedule. The short fall in the sub sample of a village is adjusted from the next selected village. This is done to bring the sample close to representativeness. A total of 29 villages located in remote areas covered in the study. In order to obtain information on the utilization of post-natal care in the Lodha community, the respondents were asked to state if they had received any health checkup/ service both for themselves or for their newly born child within the post-partum period of 6 weeks following their last delivery. The last delivery is considered in the study to avoid recall lapse by the respondents. The community by and large, was found to be culturally homogenous. Not much variation is found in the level of education and standard of living. Even though these variables are important, but we have dropped them in our analysis. As background variables, occupation, duration of married life and index of religiosity is considered. Occupation is broadly categorized into two depending on their subsistence related activities during major part of the year, i.e., 183 days in a year. The two occupational categories viz., 'Agricultural' refers to cultivating one's own land and 'Gatherers' subsists on collection and selling of forest produce. The index of religiosity is computed by using scaling technique and for this purpose following statements were asked to the respondents: believe in god; observe religious symbol; pray daily; visit

Fig.1 : The Study Area

religious places daily; impart religious education to children; believe in hell and heaven and Lodha ritual superior than others. The responses for each statement were recorded in two point scale- "Yes=1" and "No=0". Test of significance is done by computing Cramer's value.[21]

RESULTS

A little less than half of the respondents (230; 47%) stated to have received health care service at any point of time within the 6 weeks following the delivery of their last child. The information collected on the said aspect showed that postnatal health check-ups/services were received mainly at home (42%) (Fig.2). The lactating mothers were treated at home largely by elderly female family members, midwives and even by local medicine man (Kabiraj). Services of paramedical at private health dispensaries were also utilized at home but in rare and serious cases only.

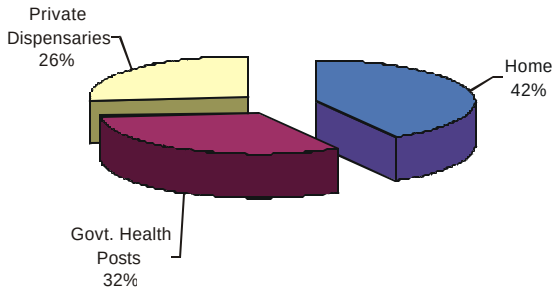

Fig.2: Sources of delivering post-natal care

Sources of delivering postnatal services with the background variables of the respondents are shown in table 1 and are mentioned below:

It is found that majority of the housewives belonging to households engaged in agricultural activities, largely visited Government hospital/ PHC/ Sub centres for postnatal services (42%), followed by those visited paramedical at private clinics (33%) and at home (25%). On the contrary the gatherers received care largely at home (51%) followed by service received at Government hospitals/ PHC/ SC (27%) and in private clinics (22%). The association between source of receiving post-natal services and respondents occupational background is found to be significant (Cramer's value = 0.199, $p < 0.001$).

Further the respondents having higher duration of married life had consulted mostly the service providers in Hospitals/ PHCs/SCs for postnatal check-up and those with lower duration of married life mostly resorted to home remedies after childbirth. The association between postnatal services received and duration of married life is not statistically significant (Cramer's value = 0.134, $p>0.05$).

The respondents with higher level of religiosity (superstitions pertaining to child birth) displayed greater reluctance to visit any institutionalized health post for postnatal check-ups but preferred to have such health check- up at home. On the other hand respondents with lower religiosity visited largely Government hospitals/PHC/ Sub Centres for postnatal check-up. The association between index of religiosity and source of receiving postnatal services is found to be significant (Cramer's value = 0.230, $p<0.0001$).

Table 1: Distribution of the respondents according to places of receiving postnatal checkup by various background characteristics

Background Characteristics	Base	Home	Govt. Hospital/ PHC/SC	Private Clinics
Occupation				
Agricultural	83 (100.0)	21 (25.3)	35 (42.2)	27 (32.5)
Gatherer	147 (100.0)	75 (51.0)	39 (26.5)	33 (22.4)
Duration of Married life (Years)				
Up to 10	111 (100.0)	53 (47.7)	26 (23.4)	32 (28.8)
11-20	92 (100.0)	34 (44.1)	38 (41.3)	20 (21.7)
21+	27 (100.0)	9 (62.5)	10 (37.0)	8 (29.6)
Index of Religiosity				
Low	55 (100.0)	10 (18.2)	27 (49.1)	18 (32.7)
Medium	127 (100.0)	56 (44.1)	41 (32.3)	30 (23.6)
High	48 (100.0)	30 (62.5)	6 (12.5)	12 (25.0)
Total	230	96 (41.7)	74 (32.2)	60 (26.1)

N. B. Figures in parenthesis indicate percentages

Out of the total sample of 500 women, 54% (270 respondents) did not availed postnatal care services during post-partum period of 6 weeks following last delivery (data not presented in tabular form) and gave different reasons for the same. Majority of the respondents did not felt the need for such services as they faced no serious problem after delivery (72%) and another 16% mentioned poverty as a cause, which had prevented them from undergoing any health check -up during the post-partum period. The remaining 12% attributed lack of time, unfriendly attitude of the service personnel and no proper knowledge of the services as reason, which forbid utilizing such services.

DISCUSSION

This study demonstrated that in contradiction to the general view as mentioned above, the higher number of Lodha women were found to have consulted one or the other source for postnatal care compared to antenatal care (43%). It is observed in the study that these services among the Lodha women are usually received at home indigenously and to a very lesser extent by Anganwadi worker or by Auxiliary Nurse Midwife. The other sources of post-natal services include services at local private dispensaries and are usually consulted during emergency.

The services by traditional healer at home or private dispensaries are charged either in cash or in kind as per their will, burdening the Lodhas economically and renders them skip their meals in exchange of health services. Further Lodhas often discontinue the regularity of their visits to Government health posts for availing such services, which ultimately dilutes the service effectiveness. Further lack of Government health posts at easy reach and unfriendly attitude of the service providers, as reported, also acts as a hindrance in the utilization of the services. So it is suggested that the health authorities need to act decisively in order to strengthen the services in these remote areas and make it accessible and affordable to the tribal people.

The study also shows that Lodhas who have adopted permanent agriculture are better than the gatherers in terms of utilization of postnatal care services. It has been observed that among the gatherers there was a feeling that once the child is born there is no need to consult any doctors unless they were subjected to serious problems. So there is a need to identify the areas of their living and launch special service to give a thrust to their health, which is hitherto neglected. Further it is found that Lodhas marry at tender age. The analysis of duration of married life also points to the fact that young mothers should be specially targeted to reach these services. Again their attitude towards life is very much molded by the level of religiosity. Greater the religiosity lesser is the utilization of the institutional services. The researcher made specific proposal with regard to the health education round the year among the tribe particularly those residing in forest areas to generate a demand for such services by generating a sense of realization towards the importance of postnatal care services and its wider implication to mother and the newly born child.

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FOODS AND BEVERAGES CONSUMED BY ABUJHMARIAS - A PRIMITIVE TRIBE OF BASTAR IN CHHATTISGARH

Rekha Singh[1] and Aruna Palta[2]

Abstract. *Study was conducted on Abujhmaria tribe living in Orcha Block (Narainpur Tehsil) of district Bastar in Chhattisgarh list of Abujhmaria families was prepared and 100 Abujhmaria families were selected randomly. A questionnaire developed by NIN was used to collect information on diet survey and socioeconomic status. It was found that they were consuming 3 meals a day and food intake was dependent mainly on availability of food. As they live in forest ecosystem their diet comprises of variety of unconventional foods viz; edible forms of flowers, fruits, tubers, reptiles, rodents and other flesh food available from the forest. Variety of foods and beverage consumed by them are Salphi, Pej. Landa, Red ant chutney etc. Alcohol plays a significant role in the social and religious life of Abujhmaria tribe.*

INTRODUCTION

Tribes constitute an important segment of the population of India. They are distributed in three principal zones namely, North-Eastern, Central and Southern zones with different dialects, cultural homogeneity and unifying social organization. Because of the scheduled living of the groups, their pattern of living, food habits, dietary practices and attitude to various aspects of life in general differs from non-tribal population.

Tribal population is more concentrated in the central region of India. In Bastar, Abujhmaria tribe inhabits in Abujhmar area. Abujhmaria tribes live in forest ecosystem and depend for their food need on local produce. Like their life style their diet also offers tremendous variations. Mostly the diet comprises of variety of unconventional foods viz., edible forms of flowers, fruits, tubers, honey, rodents, reptiles and other flesh foods available from the forest. Attempts are at hand to understand the basis of their lifestyles, food habits, custom etc. through different surveys and studies. Food being the prime need of man requires deep study in terms of quantity and quality. Very few scientists have attempted to collect data from tribal living in remote areas. Keeping this in view a study was planned on Abujhmaria tribe of district Bastar to explore various aspects of food, beverages and special foods consumed by them. Objectives of the study were as follows.

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OBJECTIVES

(i) To study the meal pattern of Abujhmaria tribe.

(ii) To know the typical food and beverages consumed by them and their method of preparation.

(iii) To know about their special foods for various occasions like births, deaths, marriages etc.

METHODOLOGY

Area: Bastar district of Chhattisgarh was selected for the present investigation and study was conducted on the Abujhmaria tribes living in Orcha block (Narainpur Tahsil).

Sample: List of Abujhmaria households was prepared and 100 Abujhmaria families were selected randomly.

Data collection: An interview schedule developed by NIN for tribals was used to collect information for diet survey. Interview schedule was pretested and necessary changes were done. The data was collected by paying repeated visit to the study area. In the initial stages, friendly discussions were done with the help of interpreter. Situation was built up so as to develop efficient rapport with the tribals. Information was collected from the head of the family regarding the nature of food consumed during past 48 hours and the entries were made in the schedule.

RESULTS AND DISCUSSION

Socio-economic status: All the tribal families surveyed were Abujhmarias, they were all non-vegetarians. All of them were illiterate and were residing in "Kaccha" house. Majority of them had a pet dog. Abujhmarias followed "Penda" cultivation i.e. occupying certain land, clearing the trees, bushes etc. and then sowing seeds in rainy season. They don't use plough for farming. Majority of them belongs to joint family.

Meal pattern: Food habits of tribals are said to be unique.[1] Abujhmaria tribes surveyed were generally consuming 3 meals a day. Food intake was dependent mainly on availability of food. Morning meal consisted of Pej or left over rice of previous night (Table-1). In afternoon Pej, Rice, Amat/Dal/Flesh food, Red ant chutney was consumed. Dinner consisted of Pej, Rice or left over vegetable from lunch. Abujhmaria tribe predominantly eats Kosra (Kutki). Kosra is the most inferior minor millets grown in India. The Abujhmaria tribe has not yet progressed to the stage of rice cultivation that requires the use of plough. The morning meal all over Bastar is taken in liquid form called Pej, Java or Gato. It is a saline pudding chiefly of rice, together with small proportion of various millets. The advantage of taking this preparation to forest is that, where there is no water source, it quenched the thirst also. The men usually go out with their gruel in a gourd flask, to the fields or forest where they work and have their lunch in between. In the afternoon also some stale gruel is taken. Similarly unique cooking practices were reported among the tribals of Madhya Pradesh.[2] They prepare a beverage "Pej" by boiling cereals with buttermilk for long time.

Table 1: Meal Pattern of Abujhmaria Tribals

Meals	Items
Breakfast	Pej/ Salphi / Landa / Left over rice of previous night.
Lunch	Pej, Rice / Amat / Flesh food / Red-ant Chutney.
Dinner	Pej, Rice / Left over vegetable from lunch / dal.

The evening meal is of boiled rice or millet taken with pulse of either Kulthi (horse gram), Urad (Black gram) or Mung (green gram) and vegetables. Abujhmarias are fond of a sauce made of Tamarind, Mango (amat), Mahua or Red or White ants. Pigs are reared for eating on festive occasions. Poultry is kept for frequent sacrifice and associated eating. These tribes does not consume milk at all. Use of spices, Salt, Chillies, Garlic, Turmeric are made to limited extent. In addition to these, drinks occupy a very important place in the life of the tribes of Bastar. The use of Mahua spirit is universal in Bastar. Other important drinks are Salphi and Chind rus, which are a fresh or fermented juice of Sago palm (*Caryota urens*) and wild date palm. Landa (rice beer) an other beverage, which is very common and made by boiling equal proportions of rice or Kosra (Kutki) and Madia (Ragi) flour and then fermenting it (Table-2). Seasonality and availability of food determines the source of food in the preparation of alcoholic beverages. It was reported that, millet based less alcoholic beverages were said to be nutritious providing proteins, minerals and vitamins.[3] Similarly, it was also found that favorite drink of "fulani herds mans" was a type of milk beverage that was prepared by souring milk in the shade.[4] Studies on diet and nutritional status of tribals indicate prevalence of varying degrees of malnutrition.[5]

Madia Pej, which is very popular beverage among tribes, is very nutritious. The protein content in madia is 8.79, fat 9.05g, carbohydrate is 47.44, calcium 500mg, iron 12mg, zinc 2mg and magnesium 110mg/100g.[6.] Abujhmaria tribe use fresh rhizomes of tikhur to prepare starchy flour, which has a medicinal potential and is considered good for peptic ulcer patient, as it provides cooling effect. This starchy flour is mixed with water and consumed in the form of sherbat. It is used as an energy drink and medicinal beverage for cooling effect during hot summer.

Barring some tribes of Kerala and Nilgiri, the tribals are generally habituated to their alcoholic drinks.[7] An alcoholic beverage "bang chang" was reported to be prepared by Monpas tribes of Arunanchal Pradesh with ground cereal or millet. Mahua flowers were said to be basic ingredient in the preparation of liquors.[8,2] Liquors prepared from fermented mango juice were taken by tribals of Srikakulam district and its consumption was about 1-2 ltr./day.[9] Home made alcoholic beverages were also prepared by tribes outside India. Amazonas of Peru use cassava in the preparation of beers nijamash substance about the consistency of buttermilk.[10] Consumption of toddy,

Table 2: Food and beverage of tribals

Food item	Ingredients	Methods of preparation
Pej (Kosra)	Kosra / Kutki (Minor millet)	In 2 lt. water 100g Kosra is added and boiled .Salt is added to taste
Pej (Rice)	Rice	In 2 lt. water 100g Rice is added and boiled. Salt is added to taste.
Madia Pej (Ragi)	Ragi (Minor millet) and Rice	In 2 lt. water 50g Rice and 50g Ragi is added and boiled. Salt is added to taste.
Maize gruel	Maize	Maize is grounded and soaked in water overnight. Next day it is boiled and in the form of thick gruel it is consumed.
Salphi	Sap of Salphi tree (*Caryota urens*)	It is a fresh or fermented juice of Sago palm.
Chind Rus	Sap of tree (Wild date palm)	It is fresh or fermented Juice of Wild date palm.
Fulee / mand (alcoholic beverage)	Mahua flowers, Rice, Kutki, Ragi or sap taken directly from forest.	Mahua flowers are collected and with other ingredients allowed to ferment for a few days. Then spirit is distilled by own indigenous distillation plant.
Red-ant chutney	Red ants, Ginger, Garlic, Chillies and Salt	All ingredients are grinned and consumed in the form of paste.
Tikhur sherbet	Tikhur *(Curcuma angustifolia)* Starch water and sugar	Tikhur starch is mixed with water and if available sugar is added.
Rice amat	Rice flour, Tamarind, Cowpea,Ginger, Garlic,Chilies & Salt	Rice flour, Tamarind, Cowpea and Salt is added and cooked. It has a poring consistency.
Imlijhor	Tamarind-pulp, Water, Salt and Dried fish	In approx. 2 lt. Water 50g Tamarind, Salt and if available Dried fish called Suksi is added and boiled. This preparation is very common in summer season. This Imlijhor is consumed with Rice or Kosra rice.
Landa (Rice beer)	Rice & minor millet (Kosra / Kutki and Madia)	Boiling equal proportions of Rice with Kosra or Madia flour makes thin paste and then it is fermented.

tapped from palm and Sago trees was a common practice among the tribes in southern and central India.[11] The tribes of Manipur and Nagaland consumed "Zu" a beer, brewed from rice and flavored with different herbs, collected from the surrounding forest. Whereas, tribals of Andaman and Nicobar Islands did not distill any liquor but consumed the Indian make foreign liquor, which they procured from the non-tribals of the plains. [11] Tribals of Orissa take rice in the form of "Pak hal" i.e. cooked rice, soaked in water .[12] Wheat was consumed during festival or sickness. Maize was consumed according to availability. Other researchers also observed similar findings.[13,14] Studies on fisherman community revealed that cereals was their major food item.[15]

Like non-tribals, Abujhmarias also prepare special foods on various occasions like births, marriages, festivals and deaths. Non-vegetarian food

items like suksi (dry fish), mutton and chicken were special items prepared on such occasions (Table-3).

Table 3: Food for various occasions

S. No.	Occasions	Food items
1.	Festival	Pej, Rice, Bengalgram, Mutton, Chicken, Chappati, Wheat flour pakora, Bobo (Rice flour and Jaggery is kneaded together and different shapes of vada are made and deep fried).
2.	Marriages	Pej, Bengalgram, Red gram dal, Rice, Chappati, Mutton, Chicken, Rice amat (puffed rice, jaggery, banana are mixed in water and served as such).
3.	Births	Pej, Rice, Mutton, Chicken, Fish.
4.	Deaths	Rice, Pej, Rice amat, Lentil, Blackgram dal.

Alcoholic drinks play a significant role in the social and religious life of tribals. Alcoholic drinks like sulphi, chind and landa are taken on all occasions.

Frequency of food intake: Data on food intake frequency of Abujhmarias revealed that among cereals, minor millets viz., kosra (minor millet) and madia (Ragi) were the main staple in the diet and were consumed daily. Wheat was consumed only on certain special occasions, pulses were not consumed daily by majority of them. Abujhmarias grew leafy vegetable either in their own compound (Homestead) or in the field. They also collected the vegetables from nearby streams, penda fields and also from places where they grow wildly. The leafy vegetables were known as "Bhaji". This was consumed as per availability (Table 4).

Varieties of fruits like Maruha, mango, jamun, guava, custard apple, tendu, chind,

Table 4: Frequency of food intake (%)

Food stuffs	Daily	Twice a week	Fortnightly	Monthly	Rarely	Nil
Cereals						
Rice	-	100	-	-	-	-
Wheat	-	-	-	-	100	-
Madia (Minor millet)	100	-	-	-	-	-
Kosra (Minor millet)	100	-	-	-	-	-
Kodo (Minor millet)	-	10	45	10	35	-
Maize	-	-	100	-	-	-
Pulses / Legumes						
Lentil	30	17	10	5	38	-
Redgram	-	40	20	40	-	-
Blackgram	40	3	57	-	-	-
Bengalgram	40	1	59	-	-	-
Cowpea	-	50	50	-	-	-
Horse gram	35	31	34	-	-	-

Green leafy vegetables						
Colocasia leaves	-	-	85	15	-	-
Amaranthus	24	32	36	3	5	-
Bathua *(C. album)*	-	-	36	34	30	-
Methi leaves	-	-	-	100	-	-
Radish leaves	-	100	-	-	-	-
Cabbage	20	-	-	-	80	-
Spinach	20	-	-	-	80	-
Koliaribhaji*(Bauhinia)*	80	20	-	-	-	-
Chezbhaji	75	25	-	-	-	-
Fruits						
Mahua	-	10	-	80	10	-
Mango	-	-	-	100	-	-
Banana	-	-	-	100	-	-
Jamun	-	35	65	-	-	-
Guava	-	65	-	35	-	-
Custard apple	-	-	-	100	-	-
Tendu / Chind / Char	-	-	-	-	100	-
Other vegetables						
Bamboo shoots	-	62	38	-	-	-
Boda(Wildmushroom)	-	-	40	35	25	-
Futto(Wildmushroom)	-	-	45	-	55	-
Mushroom	-	57	-	43	-	-
Brinjal	-	-	-	30	70	-
Pumpkin	-	57	-	43	-	-
Ladyfinger	-	-	15	13	-	72
Tomato	-	-	10	60	30	-
Bottle gourd	-	20	35	45	-	-
Snake gourd	-	40	53	7	-	-
Drumstick	-	62	38	-	-	-
Roots and tubers						
Colocasia	2	4	10	24	60	-
Yam (Zimikand)	8	10	32	50	-	-
Ginger	10	-	20	70	-	-
Garlic	10	-	20	70	-	-
Radish	10	-	20	70	-	-
Tikhur	63	37-	-	-	-	-
Carrot	-	-	-	70	30	-
Potato	80	20	-	-	-	-
Onion	50	50	-	-	-	-
Baichandi *(Dioscorea hispida)*	4	2	10	24	60	-

Alukanda (Tapioca)	8	10	32	50	-	-
Kalmal Kanda (Sweet potato)	4	2	10	24	60	-
Nagarkanda *(Dioscorea alata)*	10	-	20	70	-	-
Dangkanda *(Dioscorea bulbifera)*	20	10	40	30	-	-
Milk & Milk products	-	-	-	-	-	100
Meat/Fish/Poultry/ Mutton	2	54	18	26	-	-
Crab	2	54	18	26	-	-
Rodent	52	48	-	-	-	-
Rat	-	-	-	100	-	-
Duck	-	-	-	100	-	-
Chicken	-	-	-	50	-	-
Pigeon	-	-		50	50	-
Fish	7	2	50	41	-	-
Pork	-	-	3	97	-	-
Egg	2	1	-	-	87	-
Sugar / Jaggery	3	7	10	-	80	-
Fats and Oils						
Mustard oil	3	7	10	-	80	-
Tora (Mahua seed oil)	3	3	7	10	-	80
Spices and Chillies	20	-	10	-	70	-
Tamarind	25	-	15	60	-	-

chirongi etc. were collected from forest by tribals. Its consumption was depended on its availability. As regards to roots and tuber tapioca, colocasia, bachandi, etc. were consumed frequently. Consumption of milk was nil. Meat, fish and poultry formed an essential part of the tribal household. Duck, pigeon, small chicks were reared so that they can be used as sacrificial animals during family rituals. Intake of sugar and jaggery, fats and oil, species were almost negligible.

On the basis of this study, it is concluded that Abujhmarias are the most primitive tribes of Bastar. Their food consumption pattern is different from ours. Alcohol plays a significant role in the social and religious life of the Abujhmarias. Millet based, less alcoholic beverages are consumed by them which are said to be nutritious, providing protein, minerals and vitamins. Food intake is dependent on availability of food. Thus the study provided scope for conducing further studies for analyzing nutritional composition of variety of rare foods consumed by them like red ant chutney,

perennial leafy vegetables, landa, sulphi, tikhur sherbat etc.

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ELIMINATION OF LYMPHATIC FILARIASIS: ADOPTION OF APPROPRIATE STRATEGY

D. Das[1] and A. P. Dash[2]

Abstract. *India is one of the signatories for the WHO programme on elimination of lymphatic filariasis and planned to eliminate the disease by 2015. Under this programme an individual (except children < 2 years and pregnant women) has to consume a single dose of Diethyl Carbamazine Citrate (DEC) at a dose of 6 mg per kg body weight annually for a period of 5-6 years, which will ultimately block the transmission of the disease. Another aspect of this programme is to reduce the LF related disabilities by appropriate IEC. To achieve the goal of LF elimination, area and culture specific IEC strategies and programme monitoring should be planned diligently*.

INTRODUCTION

Lymphatic filariasis caused by three closely related filarial nematodes (*Wuchereria bancrofti, Brugia malayi, and Brugia timori)*, are transmitted by mosquito vectors. It is estimated that at least 120 million people in 83 countries of the world are infected primarily by *Wuchereria bancrofti* and to a lesser extent by *B. malayi and B. timori*[1]. In many urban areas of the world including India, *Culex* species is the major vector of *W. bancrofti.* Current estimates indicate that about 467 million people are living in filariasis endemic zones. Of these, 109 million are living in urban areas and the rest in rural areas. The common manifestations of lymphatic filariasis like lymphoedema, elephantiasis and hydrocele result from irreversible damage caused to the lymphatics by the adult worms.

The World Health Organization (WHO) initiated the Global Programme to Eliminate Lymphatic Filariasis (GPELF) in 1998. Two major developments in filariasis research were instrumental for this: Availability of newer diagnostic tools like Og4C3 ELISA and ICT card test in the detection of filarial infection[2, 3,4] and the ability of Diethyl Carbamazine Citrate (DEC) to remove microfilariae from circulation even at a single dose. It was planned that DEC at a dose of 6 mg per kg body weight, if given as mass therapy alone or in combination with albendazole, for a period of 4-6 years (fecund period of filarial worm) can block the transmission cycle of LF. Currently, this programme is largely based on repeated annual cycles of Mass Drug Administration (MDA) to endemic populations. These are based on rounds

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of community-wide distribution of single annual doses of combined drug regimens. The plan which was based not only on the interruption of transmission but also prevention of LF related disabilities, was endorsed and adopted by the Global Alliance for Elimination of LF when it met for the first time in Santiago de Compostela in May 2000.

Till date, more than 32 out of 83 endemic countries are in the eradication programme globally. India has become a signatory to it and initiated the programme in 13 districts in seven endemic states namely Andhra Pradesh, Orissa, Tamil Nadu, Bihar, Uttar Pradesh, West Bengal and Kerala. In Madhya Pradesh, first round of MDA was started in 2004.This year, the State Government is planning to implement the programme in 11 districts. The Government of Madhya Pradesh is going to start the second round of MDA, on 11th November 2005 . High compliance in the intake of drug by eligible population and consistency of mass drug administration programme are the key factors behind the success of LF control/elimination programme.

Appropriate strategies have to be planned and the problems at planning level should be solved with proper mobilization of resources and advocacy. The key factors, which should be stressed, are strong information, education and communication (IEC) strategies and prgramme evaluation (short term and long term). IEC is an important tool to achieve the desired behavioral change of the people to accept the drug. While developing the IEC strategies, the strengths and weaknesses of the targeted groups should be taken into consideration. For example, in certain rural areas of Madhya Pradesh, the knowledge about the disease is low and they give low priority to its prevention[9]. It was observed that in some households, the symptomatic individuals having filarial disease in the family consume the drug. The other asymptomatic members (many of them may be microfilaraemic) give their quota to the affected individual and do not consume the drug. Considering these observations IEC should be more culturally oriented and area specific. The IEC activities should not be limited to the hands of the programme implementing agencies and all sorts of communication techniques, advocacy tools, and media outlets should be exploited.

Evaluation of the MDA programme has to be made to monitor its effectiveness in achieving the goal of lymphatic filariasis elimination. In the absence of data regarding filariasis prevalence it will be really difficult to monitor the programme and in such cases Og4C3 ELISA/ ICT Card test can be used. However there are a few published reports in Madhya Pradesh and the primary data came from health delivery

systems. These data though form the basis of MDA programme in the State it underestimates the real problem due to the disease. In this context, data should be generated prior to and after MDA by night blood smear examination for microfilaraemia and Og4C3 ELISA/ ICT Card test for antigenaemia estimation. In parallel with the above methods, xenomonitoring of mosquito population by PCR can be used for detection of filarial infection. For measuring transmission potential, specific PCR based assays that detect only third-stage larvae can also be used.

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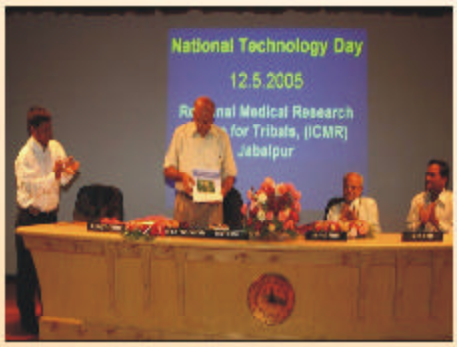
RMRCT ACTIVITIES

18th Scientific Advisory Committee Meeting in progress

Prof. A. P. Das addressing on the occasion of Foundation Day

Inauguration of National Science Day Exhibition

Science Day Exhibition



Vice Chancellor, Rani Durgawati Vishvavidyalaya Jabalpur releasing Tribal Health Bulletin and delivering his talk on National Technology Day