GEOGRAPHICAL MAPPING OF MENTAL RETARDATION AND PHYSICAL DEFORMITIES AND A CASE CONTROL STUDY OF MENTAL RETARDATION IN KASARAGODE DISTRICT OF KERALA STATE, INDIA

DR. A. SUKUMARAN

Dissertation submitted in partial fulfillment of the requirement for the award of the degree of Master of Public Health.

Achutha Menon Centre for Health Science Studies (AMCHSS)
Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)
Thiruvananthapuram
Kerala
October 2005

CERTIFICATE

We hereby certify that the work embodied in this dissertation titled '**Geographical Mapping of Mental Retardation and Physical deformities and a Case Control Study of Mental retardation in Kasaragode district, Kerala State'** is a bonafide record of original research work undertaken by Dr A.Sukumaran, in partial fulfillment of the requirement for the award of the MPH degree, under our guidance and supervision.

Guide:
Dr.P.Sankara Sarma.
Additional Professor, Biostatistics
Achutha Menon Centre for
Health Science Studies
Sree Chitra Tirunal Institute of
Medical Sciences and Technology
Trivandrum, Kerala, India.

Co Guide.
Dr.V.Ramankutty
Honorary Professor
Achutha Menon Centre for
Health Science Studies
Sree Chitra Tirunal Institute of
Medical Sciences and Technology
Trivandrum, Kerala, India.

.

Acknowledgements

This study was motivated by thousands of people suffering silently due to exposure to toxic chemicals and hence I dedicate this research paper to all those defenseless people of our time.

This study is the fulfillment of dedicated efforts of many scholars and other workers involving in each stage, unconditionally. My acknowledgements are registered to each of them in the following lines.

I express my heartfelt gratitude to Dr.P.Sankara Sarma, Additional Professor of Biostatistics, AMC, SCTIMST, for guiding me through out the research work, but for whose encouragement and constant advice, this paper would not have reached this shape**.**

Dr.V. Ramankutty, Honorary Professor of Epidemiology, AMC, SCTIMST, my co-guide, gave me timely direction and invaluable advice whenever required, during the research work. I am indebted to him beyond words.

Dr.Biju Soman, Asst.Professor, AMC, motivated me and supported me during the process of geographical mapping, applying the Epi Info-GIS principles, to make this dissertation complete. I place on record my deepest gratitude to Dr. Biju Soman..

Dr. Jayaprasad P.B, Scientist of Center for Earth Science Studies,(CESS) Trivandrum was the hand behind all the attractive and informative geophysical maps in this paper. I am immensely thankful to him.

I express my sincere thanks to the members of the Technical Advisory committee and the Institutional ethics committee for the approval of my study.

I place on record, my sincere gratitude, to the officials of the Social welfare department of Kasaragode district, for agreeing to use their staff for the data collection. Mr.P.Ramachandran, District Project Officer of ICDS, Kasaragode, Mr.V.Sudhakaran, District Social Welfare Officer, Kasaragode, Mr.M.V. Laxmanan,CDPO i/c, Kasaragode, and Mr.K.Sasi, Clerk in Manjeswaram office of the same department contributed immensely in completing this study in time. My gratitude to them is immeasurable.

The contribution by the five hundred plus anganwady workers and their supervisors of Kasaragode district is the backbone of this study. Their effort is recognized with gratitude here.

This study was peculiar in that it has been done in a charged social milieu where there was abundant scope for interruption. But the assent given by the district authorities saved the study from any such hurdles. Smt. E.Padmavathy,District Panchayath President and Mr.Minhaj Alam, I.A.S, District Collector, gave me permission without any hesitation when I approached them. I am deeply indebted to both of them.

Environmentalists of many Non-governmental organizations gave me inputs and encouraged me whenever needed. Mr. Narayananmaster Peria, Kasaragode, and Mr.Jayakumar of 'Thanal', Trivandrum are two among them. I express my deep gratitude to both. I also recognize the helps rendered by the Medical officers of the district and their staff in facilitating the data collection.

In the end, I am immensely grateful to Prof. K. Mohandas, Director of Sree Chitra Tirunal Institute of Medical Sciences and Dr. K.R. Thankappan, Head of the department of AMC, SCTIMST for enabling me to complete this study. And to all my teachers and support staff of AMC, I place on record my heartfelt gratitude.

30 October 2005. Dr.A.Sukumaran.

DECLARATION

I hereby declare that this dissertation work titled "*Geographical Mapping of mental retardation and physical deformities and a case control study of mental retardation in Kasaragode district of Kerala State",* is an original work of mine and it has not been submitted to any other institution or University.

Dr.A.Sukumaran.
Trivandrum
30 October 2005.

Contents

ABSTRACT

Background: A few villages in the foothills of Western Ghats in Kasaragode district of Kerala State were reported to have clusters of abnormal health conditions since many years. The local community alleged it to be caused by the aerial spraying of endosulfan, an organochlorine pesticide, in cashew plantations near their residences. This study is to identify any association between the pesticide exposure and mental retardation.

Objectives: To do a geographical mapping of mental retardation and physical deformities in subjects aged below 24 years, and a case control study of mental retardation.

Methodology: Using secondary data, thematic maps were generated with the help of Epi Info and GIS principles. For the case control study, data for 221 cases and 176 unmatched controls and 189 age and sex pair matched controls were collected and analyzed. Exposure measurement was through two variables, residential proximity of the parents to the endosulfan sprayed plantations and occupational handling of pesticides. The data were analyzed separately for unmatched and pair matched controls.

Results: The mean age of the cases studied was 17.4(S.D of 7.9 and 95% CI 16.4-18.5). Cross tabulation and Chi square tests of the unmatched controls gave significant Odds ratios for the variables, difficulty in labour (OR=2.27; p value <.001), birth asphyxia for the child (OR=13.69; p value < .001), neo natal sicknesses (OR= 16.37; p value <.001), history of abortions (OR=1.78; p value .029), and stillbirths (OR=2.80; p value .016) history of frequent handling pesticides (OR= 4.52; p value .003) and consanguinity of parents (OR=3.69; p value .001). In stepwise multiple logistic regression, the variables birth asphyxia (OR =16.92 with p value .000), neonatal sickness (OR=14.73; p value .034), handling pesticides (OR=4.12; p value .019), consanguinity (OR=4.25; and p value .001) and poor literacy status of mother (OR=3.63; p value <. 001) came out as the final predictors. Conditional logistic regression of the pair matched controls showed adjusted Odds Ratio to be statistically significant for birth asphyxia (AOR= 16.88; 95% CI 1.82-156.00), difficult labour (AOR= 4.03; 95%CI 1.28 –12.66), education status of father, (AOR=12.77; 95%CI .409-39.82) and residential proximity of mothers after marriage, to the endosulfan sprayed plantations (AOR=6.13; 95%CI 1.05-35.73).

Conclusion: Birth asphyxia, difficult labour and poor literacy of one of the parents were seen associated with mental retardation in the study population. Residential proximity to the sprayed plantations, of mother after marriage is found significantly associated with mental retardation in analysis of the pair matched controls.

Recommendations: Obstetric care for women in the district needs to be improved. Longitudinal follow up study of the exposed population is recommended and in the meantime the temporary ban on spraying may be continued.

Chapter I. Introduction

1.1. Background

Organochlorine pesticides had been used extensively in the agricultural sector for pest control all over the world since many years. These are chemicals peculiar in the fact that after use, they persist in the environment for many years. They bioaccumilate and biomagnify in food chains, and also get transported through various media in the environment.[1,2,3.] Recently, evidences of adverse effects of various degrees among both animals and human beings have resulted in banning the production as well as use of these chemicals in many countries .A series of studies on these chemicals, also called as Persistent Organic Pollutants (POPs) from Chile had given warning as early as 1980s. Elina Maria Celis in those studies have shown the presence of DDT, Dieldrin, Endrin and Heptachlor compounds in excess of approved levels in fruits, vegetables, meat and even human breast milk.[4] .Rachel Carson, the author of the world famous environmental masterpiece "*The Silent Springs''* who succumbed to breast cancer in 1964,fought many legal battles to ban the use of DDT, considered to be the most poisonous of all organochlorines.[5] Evidences are trickling in regarding the adverse effect of these compounds, which includes, endocrine disruptions, mutagenicity, terratogenicity, carcinogenicity, developmental defects, various defects in reproductive organs and their functions, neurotoxicity etc. Adverse effects were also being reported in other forms of life in the environment, like fish, frogs, bees, birds, cattle grazing in the fields exposed to these pesticides.[6] Endosulfan, a member of this group (with the chemical formula,6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a,hexahydro-6,9,methano-2,4,3,benzodioxa

thiepin-3-oxide) have been under use in the government owned cashew plantations in Kasargode district of Kerala state for the past three decades. The pesticide was sprayed aerially, through helicopters twice a year to control the pest, tea mosquitoes, affecting the inflorescence of the cashew trees. In recent years, abnormally high morbidity among the residents in close proximity to these cashew plantations was being reported. Congenital malformations, mental retardations, seizure disorders, cancers of different organs, high incidences of abortions in women, increasing number of sterility among couples, various forms of allergic diseases, etc are some of the commonly encountered illnesses reported by both government and non government health providers[7]. Surveys, small-scale studies, and expert committee enquiries have been going on for the last three years. Consequent to a large-scale people's outcry against the use of this pesticide, it has been temporarily banned from use since December 2001, in the state[8.] Epidemiological studies had been very few and have not been sufficient to establish a causal relationship between these symptoms and the pesticide use.

The present study aims to look into a possible association between mental retardation and prenatal exposure to the pesticide endosulfan in Kasargode district of Kerala.

Chapter 2. Review of Literature

Works on Pesticides and their impact on health of all forms of life are abundant in the medical library archives. Since these chemicals are of different groups, most of the studies are also covering them as a group rather than individual compound. The most relevant of the literatures are summarized below:

Pesticides are group of substances or mixtures of substances used for preventing destroying, repelling or mitigating any pests in the environment.[9]. The term also covers related compounds used in agriculture sector, such as fungicides, herbicides and other chemicals used to improve the agriculture output. There are broadly two groups of chemicals in this category, the organochlorines and the organophosphates. These compounds had been in wide use since many years and both create some health risks to the exposed populations. Developed countries are reassessing the health and environmental risks involved in their use frequently and regulations are being imposed. The recently published report of the Oregon State University on solid organochlorine pesticides gives detailed and updated information on the Toxicological and health impact of these groups of chemicals.[10] The report says that these are a group of chemicals, which has been in wide use for different purposes in different countries under different names. They include chemicals such as Lindane, DDT, Dieldrin, Chlordane, Endosulfan, Heptachlor, Mirex and Chlordecone. Many others are part of various home and garden products as well. Hexachlorobenzene is used as a fungicide. These chemicals are readily absorbed through skin, respiratory tract and also from gut on human exposure. Abraded skin enhances the absorption. Fat and fat solvents enhance gut absorption. While most of the solid organochlorines are not highly volatile, pesticide laden aerosol or dust particles trapped in respiratory mucus membranes lead to enhancement of absorption.

Following absorption, a significant part of them is stored in fat tissue as an unchanged compound. Part of them is metabolized and excreted through biliary and urinary tracts. Acute and chronic poisoning episodes are not uncommon. They cause neuro irritability, gastrointestinal disturbances, endocrine disruptions, reproductive dysfunctions, and various forms of dermal irritations. Effect of chronic exposure might include immunologic depression, carcinogenecity, terratogenicity, and genetic mutations.[10]

A study on Exposure of Women to Organochlorine pesticides in Southern Spain, compared the levels of 15 different types of Organochlorine compounds in the adipose tissue of 200 women living in the southern Spain. The Mediterranean region is having extensive greenhouse farming areas and is suspected to be having a very high use of many forms of pesticides since 1960s. Aldrin, Dieldrin, Endrin, Lindane, Methoxychlor, Endosulfans and DDT and its metabolites were identified in majority of the samples. The results suggested that women of reproductive age in southern Spain have been and are currently exposed to Organochlorine pesticides and because these chemicals can be mobilized during pregnancy and lactation, further research is warranted to interpret the health consequences for the children of such exposures. [11].The presence of organochlorine pesticides in human serum and adipose tissue has been reported in studies from other countries also. [12.] Humans can be exposed to these pesticides through their occupational exposure, through their environment or through the food. [13]

A Chilean study on Organochlorines, which is a kind of Meta analysis about the pesticides content of many food items like, fruits and vegetables, meat, environment and also in human breast milk. Various studies conducted during 1982,84 and 87 showed presence of DDT, Dieldrin, Endrin and Heptachlor residues in much higher levels. The amount of DDT

in Breast milk, which was higher during 1982, came down in studies of 1987, presumably due to imposing ban on its use by the country. The study showed that in 1996 hospital records showed 537 cases of toxicity, which increased to 636 in 1997. 68 percent of these were due to occupational exposure and 47 percent of them needed hospitalization. There was 3 percent mortality, which is fairly high. Cases of birth malformations were followed up during 1975 –1977 and 1988-1990, which revealed manifold increase in such instances of congenital deformities and stillbirths due to malformed fetus. These incidences were also associated with occupational exposure of father and or/mothers. Incidentally this period coincided with increased use of pesticides in the country, about 60 percent of which were imported. [14.]

NRDC, The US based environmental awareness group, Natural Resources Defense Council, portrays the story of the Silent Spring- an article about Rachel Carson, a renowned nature author from Rural Pennsylvania, who exposed the hazards of DDT and initiated a worldwide debate which ultimately led to its total banning. DDT, unlike other similar pesticides which killed or destroyed one or two species of pests, killed more than hundred species at a time causing extensive ecological damage. It was used initially in the ante malaria campaign in the South Pacific Islands during World War II, and its inventor was awarded Nobel prize later. Rachel Carson, the author of the book Silent Springs, meticulously documented the adverse effect of DDT on both humans and ecology. She had concluded that the chemical had contaminated the entire food chain of the world, destined to remain in the environment for many years and which can cause various types of cancers and genetic damage. Ironically, the author herself succumbed to cancer of breast in 1964. [5].

Eric Weltman, the Greens Party USA Senator, in 1995 came out with a comprehensive document on the impact of Organochlorine pesticide on human populations as well as the animal fauna, which ends with a remark that "the time to study has past, and the time to act has begun ". [14] The document spoke about a 400 percent increase in ectopic pregnancies in US during 1970 and 1987, decrease in sperm counts in males, increase in testicular cancers by 3-4 times in 40 years, increase in birth defects of the male genetalia and some scientists reporting a stunning increase in breast cancers. Thought there was a deficiency of scientific evidences to link these observations with pesticides, there were convincing evidences linking them in wildlife and laboratory studies. [15,16]

Mental retardation is perceived as a developmental consequence of some pathogenic process, including genetic defect, and toxic exposures. A Chinese study categorizes the etiologic factors for Cerebral Palsy in children, a common associated condition of mental retardation into four categories. These are foetal growth related factors, birth asphyxia related conditions, traumatic insults to the developing brain, and an other factors group. The last group covers many of the environmental toxins including pesticides. [17,18]. Single gene mutations and other chromosomal aberrations are known to result in altered brain development in the growing fetus. Various chemicals and toxins act as terratogens to the embryo. [19]. A longitudinally followed study of 40 Pakistani children of 6-10 years with intellectual disability showed that in more than 50 percent of cases a definite etiology was not detectable. Maternal illiteracy malnutrition and social deprivation was found to be significantly associated with mental deficiency.[20]. The large portion of the unclear 50 percent could be due to exposure of the mothers to environmental toxins, believe many researchers. The epidemiology of mental retardation study [17] showed that the adjusted covariates in the

multivariate analysis were increased risk in male children, with low birth weight, second or later born children, children born to mothers with lower educational levels and were aged more than 30 years.

Reports submitted by the District Medical Officer of Health to the Directorate of Health Services, Kerala State, as per the documents ak/18/07 and ak/07/01 were prepared [21]consequent to the local peoples demand for a thorough study into the incidents of abnormal disease manifestations in few villages in the Kasargode district of the State where the pesticide endosulfan has been aerially sprayed for controlling a type of pests to the government owned cashew plantations. These reports suggested the possible links between many health related conditions seen disproportionately high in some villages in the above referred district. These conditions included, mental and physical disabilities, seizure disorders, psychiatric disorders, infertility, repeated abortions in women, different forms of dermatological conditions, and increased incidence of various cancers. The available infrastructure in the district was not capable of conducting a detailed epidemiological study and hence the relationship between the higher morbidity and the chronic exposure to the pesticide endosulfan could not be ascertained.

A research paper by H.Saiyed, Aruna Dewan, Vijay Bhatnagar et al titled Effect of Endosulfan on Male Reproductive Development looked into the issue of male reproductive organ development and the exposure to this chemical in the referred area. The study population comprised of 117 male school students from the exposed area (aged10-19 years) and 90 combatable controls from an unexposed area. The study parameters included clinical history, recording of physical features, assessment of sexual maturity rating (SMR), serum estimation of selected hormones and endosulfan levels. The regression analysis showed a

positive association between serum lutinizing hormone levels and aerial spraying of endosulfan, and also a difference in prevalence of congenital anomalies involving male reproductive organs, though it was not statistically very significant.[22] The study suggested to do a long term follow up of these children to assess the exact significances of their findings.

Romeo. F.Quijano, Professor of Department of Pharmacology and toxicology, College of Medicine, Manila Philippines conducted a Fact Finding Field survey in this area of Kasaragode district in January 2002. [23] His observations were

*There is unusually large number of illnesses occurring among the people in these villages of Kasargode district within the cashew plantations where aerial spraying of endosulfan has been going on since the past 26 years.

* The illnesses are to be expected from the known intrinsic toxicological properties of the chemical endosulfan.

*There is no other probable cause that might explain the observed health problems. There is corroborating evidence of adverse effects on animals and the environment which are attributable to endosulfan.

* There is credible testimonials and clinical records for evidence of the various illnesses from competent medical practitioners who had been directly consulted by the affected villagers.

* Endosulfan has been demonstrated by laboratory analysis to be present in high concentrations in biological and environmental samples taken from the most affected villages in the exposed area. Based on these observations he also gave few recommendations including remediation and rehabilitation of the affected population.

Helen H. McDuffie, et al, in a cross Canada study of pesticides and health gave a description of association of specific pesticides with Non-Hodgkin's Lymphoma(NHL). The researchers conducted a multicentric, population based, incident case (n = 517)- control (n =1506) study among men in diverse occupation. Exposure to different pesticides and fungicides including organophosphorous and organochlorine insecticides, were subjected in this evaluation. They concluded that statistically significant associations were seen with specific pesticides under study, after adjustment for other independent predictors. [24.]

Birth malformations and other adverse perinatal outcomes in four U.S. wheat producing states, were studied by Dina M.Schreinemachers of the National Health and Environmental Effects Research Laboratory, USEPA. This ecologic study looked into hospital records of birth malformations during the period 1995-1997 in rural agricultural counties of Minnesota, Montana, North Dakota and South Dakota, comparing high wheat producers to low producers. The results indicated that in rural, agricultural counties where wheat acreage occupies a larger percentage of the land and where use of chlorphenoxy herbicides are higher, birth anomalies affecting different organs also is high, although he authors had shown several limitations of the study to be considered before the conclusions are accepted.[25].

Geographical mapping has become a fast developing branch of epidemiology. Many researchers have contributed to its present status. Ramankutty et al did such a mapping to corroborate the occurrence of Endomyocardial fibrosis (EMF), a condition affecting the myocardial tissue of heart, with the toxic effect from a naturally occurring monazite element Cerium, abundant in some coastal region of South Kerala. [26]. Hospital records of all cases of EMF during the period 1978-1994 were included in the study, and cases of rheumatic heard diseases from the hospital were taken as controls. Their residences were then traced to the

lowest administrative units and plotted in the geographical map of the State. The administrative units were then classified into groups based on the prevalence of the conditions and the results showed four taluks (the administrative units in local language) in the southern districts of the State, which were known areas having abundant deposits of the monazite elements. Further developments in the mapping methodology has now reached a state where the data from remote sensing satellites are made use of and computer softwares like Epi Info readily gives the accurate spatial picturisation of any village on the globe[27].

The present study is planned under a similar circumstance of great public health importance of a few villages in the Kasargode district of Kerala State, India.

Chapter-3.Objectives and Methodology

3.1.Objectives:

1. To identify the geographical distribution of the people suffering from mental retardation, in the age group, 0-24 years, in Kasargode district of Kerala State.
2. To identify the geographical distribution of people with developmental physical deformities, among the same age group, in the district and to do an epidemiological mapping for the above two conditions.
3. To find out the relationship between mental retardation and exposure to the pesticide endosulfan. (An Organochlorine pesticide)

3.2.Methodology:

The methodology adopted in this study is a combination of descriptive epidemiology and analytical case control study.

Geographical mapping was done using the secondary data pertaining to the occurrence of the mental retardations and physical deformities in Kasargode district. A recently published directory of disabled persons, undertaken by the Kasargode district Social Welfare department with assistance from the District Panchayath (Local Self Government) was used for this purpose. This document contains details of disabled individuals, prepared by a house-to-house survey, by the anganwadi workers, who identified the disabled persons and later confirmed by expert medical professionals in multidisciplinary disability assessment medical boards specially constituted for the purpose under direction from Government of Kerala, and is expected to be a near complete record. The data are tabulated into age groups 0-6,7-12,13-24, 25-49 and above 50 years categories for all types of

disability. From this record, the data for the mentally retarded and physically disabled was identified, segregated the under 24 years group, tabulated along side of population details collected from the 2001 census report for the district available with the District Informatics Center attached to the headquarters of the district administration. Since the directory was having many overlaps, panchayathwise details were available only for a few, and hence the block total of the mentally retarded and physically disabled were represented in maps in such situations. A block is an intermediate level administrative unit in the district, comprising of 8-10 panchayaths. The total population of each block in the present study was around 300,000. The geographical mapping was created and compared with the locations of cashew plantations under the Plantation Corporation of Kerala, (Fig.1) a government of Kerala undertaking, where the aerial spraying of pesticide endosulfan had been happening since many years.

The age group is limited to 0-24 because of two reasons, one because the pesticide spraying started in 1976, and two, the directory contained data in age groups of 0-6, 7-12 and 13-24,25-49 and above 50 years. So age group 0-24 is expected to cover most of the children born after 1976. These data were crosschecked and supplemented with the data available in the District Health Office, Kasargode. The prevalence of mental retardation and physical deformities in each of the blocks was then calculated. These data were used for plotting the geographical mapping with the help of shape files and software Epi Info. The plates are displayed in subsequent pages. The plates displays

1. The study setting in geographical scale.
2. The administrative units of the district, Kasaragode.
3. The geophysical map of the district showing the different altitudes.

4. The Location of the cashew plantations in various panchayaths
5. Total numbers and prevalence of mental retardation and physical deformities, and their panchayat wise distribution.
6. Map showing the different population density pattern in the district.

3.3. Study setting:

The study was undertaken at Kasargode district of Kerala State. The district is situated in the northern most part of the State. The geographical position of the district is $74^{o}51'49.938"$ to $75^{o}25'26.356"$ East longitude and 12^{o},02'34.440" to $12^{o}47"54.260"$ North latitude. The district has Arabian Sea as its western border, South Canara District of Karnataka State on its northeast and Cannanore district of Kerala State on south. The geo morphologic features of the district is given in the Epi Info plate I. The socio demographic profile of the district is given below in Table 1.

Table – 1. Socio demographic features of the district, Kasaragode, Kerala State.

Total Population	1204078
No. of Panchayaths	39
No of Municipalities	2 – Kasargode - Kanjhangad
No of Revenue Division Blocks	4 - Manjeswaram - Kasargode - Kanjhangad - Nileswaram
Total area under PCK Plantation	4696 Hectares Under 4 Divisions Spread over 11 Panchayaths.
No of major rivers	12

The process of geographic mapping was carried out using the Epi Info software incorporating Geographical Information System support and plates were generated. These

plates are shown in the following pages. The geographic relief plate shows the altitude differences in the different panchayaths of the district, the plates with total number of disabled population in each panchayath, prevalence of mental retardation and physical deformities in another one. One plate shows the spatial location of the government owned cashew plantations (PCK Plantations). These pictures reveal that the plantations are located in high altitude places in the district, the population density is sparse in these areas, the prevalence of mental retardation is slightly above the block average in most panchayaths. These findings need to be corroborated with other geo physical features like slope of the area, watershed pattern, river routes, and exact location of the cases. These are obviously not within the resources of this dissertation. The data source for mapping the prevalence is the directory of the disabled in the district published by the Kasaragode district panchayath in association with the district social welfare department during the period 2003-2004. The following table depicts the data.

Table :2. Prevalence of Mental retardation and Physical deformities in All panchayaths of Kasargode district. Kerala. (Data source: Directory of the disabled in the district, Kasaragode, published by Kasaragode District Panchayath. 2003-2004.)

Name of Panchayath	Prevalence (per 1000 population)	
	Mental retardation	Physical deformities
A.Block Manjeswar	***1.4***	***2.4***
1. Belur *	2.1	-
2. Kumbadaje*	1.8	-
3. Enmakaje *	2.0	-
4. Badiaduka *	2.2	-
5. Mangalpady	-	2.6
6. Vorkady	-	1.9
7. Puthige	0.9	-
8. Meenja	-	-
9. Manjeswaram	-	3.4
10. Kumbala	-	-
11. Paivelike	2.3	-
B Block Kasargode	***1.6***	***4.0***
12. Karaduka *	2.3	-
13. Muliyar *	2.5	-
14. Kuttikole	1.6	-
15. Delampady	1.9	-
16. Chengala	1.3	-
17. Chemnad	1.5	-
18. Bedaduka	2.0	-
19. Madhur	1.2	-
20. Mogral Puthur	1.4	-
C.Block Kanjangad	***2.2***	***4.3***
21. Ajanur *	1.8	6.5
22. Kallar *	2.0	5.1
23. Panathady *	2.0	2.7
24. Pullur-Peria*	3.1	4.0
25. Uduma	1.7	-
26. Balal	3.3	-
27. Kodom Belur	1.5	-
28. Madikkai	2.1	-
29. Pallikkara	1.0	-
D.Block Nileswar	***1.7***	***3.6***
30.KayyurCheemeni*	1.8	3.4
31. Cheruvathur	1.6	4.5
32. Nileswar	-	4.0
33. Pilickode	2.0	3.8
34. West Eleri	1.7	3.8
35. East Eleri	1.5	2.7
36. Trikkaripur	1.5	3.7
3.KinanurKarinthalam	3.6	3.2
38. Padanna	1.9	4.6
39. Valiyaparamba	1.7	3.6

3.4. Sample size for Case –Control study:

Assuming that the expected percentage of pesticide exposure in cases as 25 percent and among the controls as 15 percent and deciding an alpha error to be 5 percent and the power of the tests to be 90 percent, we calculated the sample size as 295 using Epi Info. Thus a total of 300 Cases of Mental retardation were selected for the study. Regarding controls, it was decided to take 2 sets of controls, one control pair matched for age, sex and another without matching.

3.5. Sample selection procedures:

The directory of the disabled persons prepared and published by the Social welfare department in collaboration with the Kasargode District Panchayath (Local Self Government) was taken as the base document. This directory contained list of persons with mental retardation and physical deformities, in age groups of 0-6,7-12,13-24, 25-50 and above 50 years. From this all entries in age group upto 24 years were identified and serially numbered to form the sampling frame for the present study. Three hundred cases were then selected by a simple random method using the random digit table. Whenever a randomly selected digit showed a repetition of case numbers, the next un repeated number was selected for identifying cases. The name and addresses of all such selected cases were then made into a separate list. From this list, cases belonging to each ICDS project areas were segregated for easy administration of the questionnaire. We decided to select one control for each case, of the same age group and sex, from the same village as that of the cases, but not from the immediate neighborhood. This group formed the matched paired controls. We also decided to collect a set of unmatched controls, by selecting 75 apparently normal individuals of the same age group, 0-24, at random, from each of the 4 ICDS Blocks, so as to form a second

group of 300 unmatched controls. The District Social Welfare officer and District ICDS project officer were consulted for permission to use the anganwady workers of their department as data collectors. (Anganwadys are pre primary non formal education and recreation centers for the rural children below 6 years, manned by two women, one worker and another helper, and gives service for a population of about 1000. The administration of these centers are through the Social Welfare department of the government, and these centers also acts as supplementary nutrition centers for the pregnant and lactating mothers of the area.) And on agreement, the anganwady workers under whose work station the randomly selected cases belonged were identified during their monthly review meeting of June 2005. the Principal investigator personally attended these meetings and gave a brief sensitization about the study, its methodology and discussed the questionnaire in detail to clear their doubts about each of the questions. The need to explain to the parents of the study subjects, the need to get informed consent, and time frame to be adhered was all explained to the anganwady workers.

3.6. Data Collection Tool:

A structured interview schedule incorporating the informed consent (see appendix-I), previously determined variables for the sociodemographic data pertaining to the cases and controls prepared first in English and subsequently translated to local language (Malayalam) was prepared and approval obtained by the technical committee and institutional ethics committee of the Sree Chitra Tirunal Institute of Medical Sciences and Technology, Trivandrum. Extreme care was taken to get all possible data regarding the exposure to the pesticide and also all known confounders. The interview schedule was pretested and practicality ensured. (The list of variables identified and the English version of the interview

schedule is appended.) The schedules were then printed in two colours, pink and blue, pink for cases and blue for controls, to make collection as well as compilation easier.

3.7. Data collection and analysis:

The investigator after briefing the data collectors who, described earlier, are the anganwady workers selected from the 870 of such workers based on their proximity to the "cases," distributed the interview schedule along with support stationeries, during the sectoral meetings of July, and requested them to return all the filled forms during their next meting. The departmental supervisors of ICDS were requested to give necessary guidance and supervision during the course of data collection. The investigator camped at the district headquarters at frequent intervals to monitor the process and also took part in data collection in few occasions. This direct data collection helped to cross check the accuracy of inclusion of "cases" as the study subjects. The filled up schedules were then collected during the subsequent review meetings of the workers, though, even after repeated attempts, only 221 of cases, and 365 of controls could be retrieved ultimately. Frequent changes at the workforce level, complacency of the supervisors, the unexpected election to the local self-governments, and also the unusually heavy monsoon and time constraint of the study could have been some of the reasons for the incomplete retrieval of the schedules.

3.8. Expected outcome:

The study expected to bring out the strength of relationship, if any, between the parental exposure to pesticide endosulfan and the abnormal presentations of mental retardations in the villages of Kasargode district of Kerala. It can also show the relationship with other variables like role of consanguinity, maternal and paternal age and education etc with the outcome variable. The randomization of the cases and controls is expected to

improve the validity of the study. A possible limitation of the study will be the incompleteness of the base document, the directory of the disabled persons. However, even if it were incomplete it would have missed some of the mild forms of the conditions only, which will not affect the validity of the study. The mapping will show the geographical distribution of cases of mental retardation and physical deformities in the district which, when compared with the areas of cashew plantations under pesticide use, might strengthen the association if present.

3.9. Ethical considerations:

The study was approved by the Institutional Ethics Committee of SCTIMST, Trivndrum. This study involved the mentally and physically challenged persons as the study subjects and thus from the ethical perspectives are considered the “vulnerable groups”. But there were no invasive procedures involved in the data collection. Nevertheless, instructions given by the ethical committee to ensure confidentiality and human dignity were strictly adhered. The local community leaders and the district administration were informed about the study and their assent obtained, the parents or the immediate caregiver of the subjects were adequately explained about the nature of the study and their informed consent obtained, the study subject, wherever they could understand, were told about the study and informed consent obtained. We came across only one case, whose parents were not willing to participate in the study, which was dropped. The data thus collected were compiled and stored as hard copies, duly numbered.

3.10.Dependent variables/Outcome Variables:

The outcome variables for this study identified are

1. Mental Retardation

2. Physical deformities - both excluding traumatic cases.

3.11.Independent Variables:

1. Maternal age.
3. Paternal age.
4. Educational levels of parents.
5. Financial status of the families.
6. Parity.
7. Nature and place of delivery.
8. History of Neurological disease /deformities in parent's families.
9. Drug intake during first trimester of pregnancy.
10. Infectious diseases during the pregnancy, trimester wise.
11. Difficulty during labour.
12. Birth asphyxia-pre natal, intra natal and neo natal.
13. History of trauma to child during delivery
14. Consanguinity in marriage.
15. Substance abuse like tobacco, alcohol, chewing.
16. Occupational exposure to pesticide, before marriage and after marriage.
17. Residential proximity to the cashew plantations (endosulfan sprayed) before and after marriage.
18. Duration of exposure.
19. Source of drinking water.
20. Source of any other chemical contaminants in the neighborhood
21. Disease category.

3.12.Operationalization of the variables:

1. Age –defined as age as reported by the subject/parent.
2. Category of disability- It was divided into 4 categories, 1=mental retardation, 2=physical disability, 3=combination of both and 4=no disability. In most cases, it is expected that a certification by the medical board will be available. In cases where it is not available, parent's statement is taken as the final.
3. Parity: defined as the birth order of the study subject.
4. Consanguinity- blood relationship between husband and wife before marriage.
5. Financial status- Here the governments' classification of families into Above Poverty Line (APL) and Below Poverty Line (BPL) is adopted. If the families are not having such identification cards, the status is assessed by appearance of house, availability of electricity and water supply. If all three present, that household is considered as APL. For this, houses are categorized into kucha/pucca tiled/rcc structure.
6. Educational levels of parents: Considered into the following categories as per the statements of the parents:

   a. Primary education – attended schools upto or completed 7 th standard.

   b. Secondary level – attended schools upto or completed 10 th standard.

   c. Above Secondary- above 10 th standard

   d. Illiterate.
7. Occupation of parents- Data regarding occupation is collected as five groups, domestic work, paid labour (agricultural or coolie works), cashew plantation

labourer, office or school jobs, and others which will include all self employments, beedi works, fishing, small scale business, drivers etc.

8. Personal habits- Presence or absence of habits like smoking, consuming alcohol, Chewing Tobacco, either alone or in combination were collected.
9. Place and type of delivery – Information about this is collected from the parent, preferably the mother. Since the district does not have any major rehabilitation centers, role of other caregivers were very limited.
10. Problems during delivery- Mothers were asked about difficulties during delivery such as labour pains lasting more than 24 hours, multiple fetuses, premature labour, antepartum haemorrhage, convulsions in mother or child. If none of these were present it was taken as normal.
11. Birth asphyxia- Data pertaining to birth asphyxia of the newborn is collected by two questions, one whether the child cried immediately after birth, and if not approximately how much time after the baby cried. A time gap of more than half an hour was taken as abnormal.
12. Major sickness for the child during the first year- Information was sought to identify major illnesses like delayed mile stones like delay in turning over, delay in holding the head straight, delay in sitting and walking. Major trauma and convulsions in childhood also was enquired into. Congenital anomalies of the limbs or any internal organs appropriately certified by medical experts were also noted. Minor ailments like febrile episode, diarroheal diseases, ARIs, etc were noted under ‘other’ category.

13. Major sickness for the mother during pregnancy, especially during the first trimester, was enquired into. Eruptive fevers, uterine bleeding, diabetes, hypertension, convulsive disorders, and generalized edema were explored and accepted as the parents reported.
14. Drug intake during pregnancy-Any category of drugs, like routine supplementation, special drugs like anti emetics, etc.
15. Number of abortions and still births- Questions were asked to the mother whether she had experienced abortions or still births ever, and if so how many times. Only spontaneous abortions were included under this.
16. Hereditary diseases in the family of either of the parents- Information about occurrence of any major illness among immediate family members of both mother and father were collected. Care was given to identify conditions like mental diseases and congenital deformities.
17. Residential proximity to the pesticide sprayed cashew plantations- This was the most important risk factor suspected in the study. An accurate measure of the exposure was practically difficult and hence, the distance from the outer border of these plantations to the point where either of the parents resided was taken as a proxy measure. Since the culture of the community was such that the women before her marriage resides in her parents house, and after marriage, lives in her husbands house, the variable was measured as before and after for the mother and one measure for the father. Additional information in this context also was sought, i.e., whether the family lived in any other place having a close proximity to such plantations.

18. Occupational exposure to pesticides- Information on this variable was sought through enquires into the type of occupation, and also by a direct question as to whether the respondent was involved in frequent handling of pesticide in any way.
19. Consanguinity- In the local culture, blood relationship meant children of paternal or maternal uncles. This was accepted for the present study situation.
20. Illnesses in either of the parents or siblings of the study subject were enquired into and accepted as reported. These were then coded after classification into mental disorders, deformities, combination of both or others.

3.13.Statistical Analysis:

The data were entered in Excel. Analysis was done using SPSS for Windows version 11.0 and Epi Info version 3.3 for deriving Odds ratios and adjusted Odds ratios.

Chapter 4.Results

The overall response rate for this study is 65.5 percent, ie, we could collect data from 590 out of the planned 900. This includes 225 cases, 189 pair matched controls and 176 unmatched controls. There was one case of an adopted child, which unfortunately had developed mental retardation and nothing was known about *the defacto* parents and so we excluded this case for analysis. Though we planned to collect data for subjects under 24 years, on actual collection few cases turned out to be above that age , probably because of the time lag between the preparation of the directory and the data collection, and some could be errors as well. Hence 3 cases with ages above 30 were excluded from analysis. Thus there were 221 cases after all exclusions. The apparent diminution of the response rate is not due to the lack of response from the parents, but insufficient compliance by the data collectors. The results of the data analysis is as follows:

4.1.Frequencies:

4.1.1.Sex distribution - Of the study subjects, 50.5 percent of the cases and 49.5percent of controls (both matched and unmatched taken together) were males. Further explored sex differentials are as given below:

Table: 3 - Sex distribution of the study population.

Sex	Unmatched Controls N=176	Cases N=221	Matched controls N=189	Total N=586
Males	70	125	101	296
Column %	*(39.8)*	*(56.6)*	*(53.4)*	*(50.5)*
Females	106	96	88	290
Column %	*(60.2)*	*(43.4)*	*(46.6)*	*(49.5)*

Total	176	221	189	586

4.1.2.Mean Age: The age related statistics of the study subjects are as

	Cases	Matched Controls	Un Matched Control
Mean	17.4	16.6	15.0
Std Dev.	7.9	6.3	6.9
95%CI	16.4-18.5	15.7-17.5	13.9-16.0
Median	17.0	16.0	16.5

4.1.3. Mean age of the mothers of cases is 42.95 with St.Dev of 10.20 and 95% CI as 41.6-44.31 and that of controls are 39.90,9.54,and 38.92-40.88. Computed value of the mean age of the mother at the time of delivery of the study subject was found to be 25.35 with a SD of 7.45 and that of controls 23.74 and SD 5.78.

The age group pattern of the cases and controls were:

Table - 4. Age groups of subjects.(n=586)

(Percentages given in brackets)

	<6 yrs	7-12 yrs	13-19 yrs	20-26 yrs	> 26 yrs
Cases	8 (3.6)	48 (21.7)	81 (36.7)	74 (33.5)	10 (4.5)
Matched Controls	11 (5.8)	42 (22.2)	68 (36.0)	62 (32.8)	6 (3.2)
Unmatched Controls	34 (19.3)	25 (14.2)	64 (36.4)	50 (28.4)	3 (1.7)

Reason for few cases outside the originally planned < 24 years was the time lag between the preparation of the directory and the data collection.

4.2. Other socio demographic characteristics:

Among the population studied, 62 per cent of the cases and 67.9 percent of controls belonged to the below poverty category. The yardstick for assessment of the financial status was the government issued cards. The break up for matched and unmatched controls were, 62.4 percent and 73.9 percent respectively. 59.9 percent of cases and 40 percent of

unmatched controls used common salt for cooking. Mother's occupation in 70.5 percent of cases and 63.6percent of unmatched controls were domestic works and only 1.35 percent of cases and 0.5 percent of controls worked in the pesticide sprayed cashew plantations. Further break up of the occupation results are given in the table below:

Table: 5. Occupation details –mother (in percentage)

Occupation	Category	
	Cases (n = 221)	Unmatched Controls (n = 176)
Domestic works	70.5	63.6
Agriculture Coolie works	15.4	15.3
Cashew plantation labourer	1.35	-
Office/school work	0.9	2.3
Others (includes self employments, beedi works etc.)	11.8	18.8

Similarly, for occupation of fathers, 68.8 percent among cases were engaged in agriculture related work either self or paid labor, and only1.1 percent were engaged in the pesticide sprayed cashew plantations. Of the unmatched controls, the figures are 76.8 percent and only 1 percent. Details of occupation of fathers are given in the table 6.

Table. 6. Occupation –father. (Values in %)

Occupation	Category	
	Cases	Unmatched Controls
Agriculture	18.1	26.7
Coolie works	50.7	50.6
Office/school	2.7	4.0
Cashew plantation works	0.5	1.1
Others (Includes, small business, Self employments, fishing, driving etc)	28.1	17.5

Personal habits of both parents were explored and the results obtained are given in table 7. A marked difference in substance use is observed between parents.

Table .7. Personal habits of parents.(in percent)

Habits	Father		Mother	
	Cases	Unmatched Controls	Cases	Unmatched Controls
None	38.0	53.4	83.7	89.8
Smoking	24.9	17.0	1.4	0.5
Alcohol use	5.4	4.0	--	0.6
Chewing tobacco	6.8	9.7	12.7	7.4
Combination of one or more	16.3	13.6	1.4	1.1
All	8.6	2.3	0.5	-

Educational levels of both parents were enquired into and the results are given in the following table. Initially the educational attainments were categorized into four sub groups, such as no education, below or up to primary level, below or up to secondary level and above secondary level, which were later categorized into literate and illiterate.

Table: 8- Educational status of parents (in percents)

Educational levels	Father			Mother		
	Cases	Unmatched Controls	Matched Controls	Cases	Unmatched Controls	Matched controls
Illiterate	20.4	9.1	12.7	26.8	12.5	16.2
Upto/ below primary	57.0	58.5	60.8	53.8	41.5	54.0
Upto/ below Secondary	18.1	26.1	18.5	14.5	33.0	22.0
Above secondary level	4.5	6.3	7.9	5.4	13.1	7.4

4.3.Pregnancy related events:

We collected information regarding significant events during the pregnancy of the study subjects. These included,

a. Birth order.

b. Type and place of delivery.

c. Problems encountered during the delivery.

d. Time/Time gap for first cry of the newborn

e. Major illnesses for the mother during the pregnancy.

f. Details of medication for the mother especially in the first trimester.

g. History of abortions and stillbirths for the mother

4.4.Birth Order:

Responses for the birth order were collected as whether the study subject was a first order birth, a second, a third or one between fourth or above. The frequency of first order births in matched controls was 45 percent and that of order fourth or above was 20.5 percent. Further details are as per Table 9.

Table:9- Birth order of study subjects (in percentage)

Birth Order	Category	
	Cases	Unmatched Controls
First	30.8	36.9
Second	19.9	30.7
Third	18.5	13.6
Fourth and above	30.7	20.0

The nature and place of delivery data showed that 71.6 percent of cases had a hospital delivery, of which 6.8 percent being surgical deliveries, and less than 1 percent (only one

case) being a forceps extraction. 80 percent of controls had hospital deliveries. Home deliveries were partly assisted by local dais (Traditional birth attendants) and partly with the help of experienced relatives or neighbours, customary to the local population. Given the health care infra structure in this part of the state 25 years back, these figures are not surprising. We also probed into various adverse experiences during childbirth such as,

a. Prolonged labour pains, lasting for more than 24 hours,

b. Antepartum haemorrhage,

c. Premature delivery,

d. Multiple fetuses,

e. Convulsions for either the mother or the neonate.

Fifty seven percent of cases and 32-37 percent of controls had some form of difficulties during their deliveries. The details of such adverse experiences are given in the table 9.

Table: 9 – Adverse experiences during pregnancy and childbirth.

Adverse experiences during pregnancy and child birth	Category		
	Cases	Unmatched controls	Matched Controls
No problems	43.0	63.1	76.2
Prolonged labour pains	33.0	32.4	29.2
Ante partum haemorrhage	5.0	1.7	2.7
Premature delivery.	5.4	0.6	-
Multiple fetuses	1.4	1.1	-
Convulsions for mother.	1.4	0.0	-
Convulsions for the newborn	10.9	1.1	1.1

Among the cases, 32.6 percent of newborns had risk of birth asphyxia, as they did not cry immediately after birth, compared to 3.4 percent of unmatched controls and 2.1 percent

of matched controls. Since the cry of the newborn immediately after birth is considered to be a powerful indicator of adequate oxygenation of the newborn, lack of immediate cry is the indicator for birth asphyxia, which could result in significant and long term sequlae in growth and development of the child. Antenatal illnesses for the pregnant mother, including eruptive fevers, which could interfere with the developing fetus, was probed and positive results were seen in 13.6 percent (out of which, eruptive fever constituted only 0.9 percent) for cases and 2.8 percent for unmatched controls and 0.5 percent for matched controls. Role of any teratogenic drug intake during the early months of pregnancy also was looked into and 85.9 percent of cases and 96 percent of unmatched controls did not take any drugs other than routine supplimentation during their early pregnancy. There were considerable differences in history of abortions and stillbirths in the mothers. 23.5 percent of cases and 14.8 percent of unmatched controls had one or more abortions in the past. For the matched controls the value was 13.2 percent. So also, 10.4 percent of cases and 4 percent of unmatched controls and 1.6 percent of matched controls gave a history of stillbirths. Of this, 8.1 percent of abortions and 1.8 percent of stillbirths among mothers of cases were more than one episode, which is significantly higher than the reported country or state averages.

4.5.Events related to the newborn:

The interview schedule explored certain important events related to the newborn child. These included,

a. Risk factors of birth asphyxia,

b. Possibility of teratogenicity

c. Neonatal diseases affecting the growth and development.

d. Chances of a hereditary condition.

The direct indicator for birth asphyxia was whether the child cried immediately after delivery. Various problems during pregnancy can be taken as indirect indicators of prenatal, intra natal or postnatal anoxia to the child. As mentioned earlier, 32.6 percent of cases did not cry immediately after birth in contrast to 3.4 percent among unmatched controls and 2.1 percent in matched controls. A good number of these instances might have suffered a brain damage, as most of these cases could be home deliveries as well. Teratogenic risk was not significantly observed in the study. Only 1.8 percent of cases had a history of non-supplementary drug intake, and <1 percent of mothers had any eruptive fevers. Neonatal diseases which can affect the growth and development of the child was probed by way of questions directed towards any major infections of the CNS, major trauma, developmental milestones, seizure disorders, and other ailments. Significant responses were observed regarding delayed milestones (5.0 percent of Cases and 1.1 percent of unmatched controls), infantile seizures (15.0 percent of cases and 0.8 percent of unmatched controls and 0.5 percent of matched controls). 24.5 percent of cases and 4.7 percent of controls had various other illnesses during the first child. These included recurrent ARI and ADD.

Table-10: Major illnesses during infancy of the subjects

Major illnesses during infancy	Category		
	Cases	Unmatched Controls	Matched Controls
Delayed Milestone	5.0	0.5	-
Convulsions	15.0	0.8	0.5
Organ deformities	2.3	0.0	-
Others	24.5	4.7	4.8

4.6.Role of Heredity:

Many conditions like mental retardations, deformities and seizure disorders run in families. Hence this study ought to look into the role of heredity. The variables, which we incorporated for these factors, are:

a. History of familiar disease in mother's family.

b. History of similar illnesses in fathers side.

c. Similar illnesses among siblings

c. Consanguinity in marriage.

Fifteen decimal eight percent of cases and 5.8 percent of controls had a history of one or other type of illnesses in the mother's side, and 12.2 percent and 6 percent in father's side. Similarly 19.5 percent of siblings of cases and 4.1 percent of controls had a sibling suffering from similar illness. The conditions, which we considered under this variable were, mental disorders, physical deformities since birth, combination of both and a group for other illnesses. The responses for the 'other' category were fairly high, i.e. 12.2 percent for mothers and 7.3 percent for father, but most were proxy reported diseases like asthma, diabetes, hypertension and rheumatism. Consanguinity was a notable finding. 14.9 percent of cases had a consanguineous marriage of their parents. For unmatched controls it was 4.5 percent and for the matched controls it was9.5 percent. Detailed analysis of these findings will be done in the subsequent sections.

4.7.Indicators of Exposure to pesticides:

The main objective of the study was to assess the differences in exposure to pesticide endosulfan between the cases and controls. The exact measurement was not practical because of the nature of the study, i.e., being a dissertation study with limited resources, and hence certain crude and indirect indictors were used instead. They are,

a. Residential proximity of the mothers before marriage,

b. Residential proximity of mother after marriage.

b. Residential proximity of fathers.

c. Data regarding staying elsewhere, close to the pesticide sprayed plantations.

d. History of frequent handling of pesticide, occupational or otherwise.

Residential proximity of mother and father was assessed by the data collector, in consultation with the parent and also the neighbours present during the data collection. The cultural pattern in this region is, for women, to stay with her parents till marriage, and then shift the residence to the husbands' home after marriage. Hence information for residential proximity before and after marriage was collected for mothers. In some instances it was also seen that, after marriage the couples shifted to a different residence. The findings are given in the following table. The apparent differences in these variables were not statistically significant, except that for the handling pesticide variable. But the paired data analysis is giving a different result, which will be dealt with later. It is also noted that the mean duration of stay by these families in their respective residential areas are 23.2 years for Cases, 19.97 years for unmatched controls and 22.1 years for matched controls.

Table-11. Exposure to pesticides. (%)

Variables	Cases (n=221)	Unmatched controls (n=176)	Matched Controls (n=189)	p-value
Residential proximity –mother before marriage, within 5 kms	19.4 (n=16)	16.5 (n=11)	14.3 (N=11)	0.426
Resid.proximity –mother after marriage, within 5 kms	23.5 (n=19)	21 (n=16)	18 (n=15)	0.361
Residential proximity father, within 5 kms	22.2 (n=19)	18.2 (n=11)	17.5 (n=19)	0.313
Frequent handling of pesticides	9.5	2.3	2.4	0.000

4.8. Unmatched analysis results:

We did bivariate cross tabulation for the following variables, for the unmatched controls and matched controls together first, and separate next to identify the differences if any. The variables were,

a. Birth order
b. Difficulties in labour
c. Baby cry immediately after birth
d. Major sickness for the child during first year.
e. Antenatal sickness for the mother.
f. History of drug use during the first trimester
g. No of abortions and still births
h. Familial disease in mothers or fathers family.
i. Residential proximity for mother before marriage, and after marriage and also for father to the endosulfan sprayed Cashew plantations.
j. Occupation of both parents
k. Personal habits of both parents.
l. Drinking water source
m. Frequent handling of pesticides by either of the parents.
n. And Consanguinity.

The consolidation of the results, in a comprehensive form is given below:

Table: 12. Cross-tabulated variables- Cases with unmatched Controls
(N for Cases=221, unmatched controls = 176)

Variable	Categories	Proportions (%) (actual count in ( )		Odds Ratio	95% C.I	p-value
		Cases (n=221)	Controls (n=176)			
Birth Order of subject	0-Primi gravida 1-Multigravida*	30.8 69.2(153)	36.9 63.1(111)	1.318	.867-2.003	.196
Problems during delivery	0-No problems 1-Difficult labour*	43.0 57.0(126)	63.1 36.9(65)	2.265	1.510-3.398	.000
Baby cry immediately after birth	0-Yes 1-No *	67.4 32.6(72)	96.6 3.4(6)	13.691	5.786-32.399	.000
Major sickness for the child during first year	1-Yes * 0-No	15.8(35) 84.2	1.1(2) 98.9	16.371	3.879-69.088.	.000
No. Of Abortions	0-None 1-One or more*	76.5 23.5(52)	85.2 14.8(26)	1.775	1.056-2.985	.029
No. Of Still births	0-None 1-One or more *	89.6 10.4(23)	96.0 4.0(7)	2.804	1.174-6.698	.016
Familial disease-mothers' side	1-Yes * 0-No	2.7(6) 97.3	0.6(1) 99.4	4.884	.582-40.948	.106
Familial disease –fathers' side	1-Yes * 0-No	4.1(9) 95.9	0.0(0) 100	.546	.499-.598	.007
Residential proximity – mother, before marriage	1-Within 5 Kms * 0-Outside 5 Kms	12.2(27) 87.8	10.2(18) 89.8	1.222	.649-2.299	.534
Residential proximity-mother, after marriage.	1-Within 5 Kms * 0-Outside 5 Kms	23.5(52) 76.5	21.0(37) 79.0	1.156	.717-1.864	.552
Residential proximity-father.	1-Within 5 Kms * 0-Outside 5 Kms	22.2(49) 77.8	18.2(32) 81.8	1.282	.780-2.108	.327
Literacy – mother	1-Illiterate * 0-Literate	26.2(59) 73.8	12.5(22) 87.5	2.491	1.456-4.266	.001
Literacy-father	1-Illiterate * 0-Literate	20.4(45) 79.6	9.1(16) 90.9	2.557	1.390-4.703	.002
Handling pesticides frequently	1-Yes * 0-No	9.5(21) 90.5	2.3(4) 97.7	4.515	1.520-13.409	.003
Consanguinity in marriage	1-Yes * 0-No	14.9(33) 85.1	4.5(8) 95.5	3.686	1.656-8.203	.001

* denotes risk groups

These results showed statistically significant differences among the study subjects in nine out of fifteen selected variables except, the residential proximity of both parents, as well as the familial disease in both parents and birth order of the study subject. The confounding effect of many variables is to be explored in depth in such a situation.

The analysis revealed that difficulties in labour, birth asphyxia, neo natal sickness for the child, history of abortions and still births for the mother, history of frequent handling of

pesticides, and consanguinity in marriages were predictor variables associated with mental retardation in offspring. The association of these variables were statistically significant. In case of Residential proximity of the parents to the pesticide spayed cashew plantations, though the Odds Ration is above 1 for both parents, the association was not statistically significant.

4.9. Matched Analysis results

For the matched control group we adopted paired test method of analysis. Cross tabulation was done followed by the Mc Nemar Test and Odds ratio and confidence intervals were calculated using Epi Info. The results are given below in Table .13. Since in paired analysis the proportion of each study variables does not indicate much, it is not given in the table form.

Table :13 –Cross Tabulation of Cases vs. Matched Controls (Paired Data)
(N = 189 pairs)

Name of Variable	Categories	Odds Ratio	95% Confidence Interval	Mc Nemars test p-value
Educational status-mother	0-Literate 1-Illiterate	**8.33**	4.99-14.73	**0.000**
Educational status-father	0-Literate 1-Illiterate	**19.28**	9.51-44.84	**0.000**
Birth order	0-Primigravid 1-Multigravid	**2.17**	1.39-3.40	**0.005**
Delivery type	0-Hospital 1-Home	1.60	0.91-2.84	0.096
Problems during delivery	0-No problems 1-Difficult labour	**9.12**	4.58-20.30	**0.000**
Baby cry (Birth Asphyxia)	0-Cried, no asphyxia 1-not cried.	**30.50**	8.90-185.6	**0.000**
Neonatal sickness	0-No major sickness 1-Yes	**2.15**	1.26-3.79	**0.004**
Abortions,	0-None 1-One or more	**2.12**	0.29-4.25	**0.006**
Still births	0-None 1-one or more	**9.50**	2.56-60.39	**0.002**
Residential proximity-mother before marriage	0-Reidence outside 5 kms 1-Residence within 5 kms	1.52	0.98-2.37	0.222
Residential proximity-mother after marriage	0-Residence outside 5 kms 1-Residence within 5 kms.	**2.83**	1.14-7.83	**0.037**

Residential proximity-father	0-Residence outside 5 kms 1-Residence within 5 kms	1.80	1.01-3.17	0.185
Handling pesticides	0-Yes 1-No	**5.33**	1.68-22.92	**0.005**
Consanguinity	0-yes 1-N0	1.85	0.97-3.65	0.080

From this analysis, the most striking observations are the relationship between the dependent variable, mental retardation with predictor variables such as educational status of parents, problems during labour, birth asphyxia, history of stillbirths, Residential proximity of mother after marriage and handling pesticides. Since we wanted to find out the association with pesticide exposure, especially the residential proximity factor, we did multivariate analysis also. The results of the same are given in the following table.

Chapter 5. Multivariate Analysis.

5.1.Multivariate Analysis of Unmatched data:

The multivariate logistic regression was done with data of unmatched controls and pair matched controls separate. The results of multivariate logistic regression for unmatched controls using SPSS is as follows:

Table –14 : Multivariate Logistic Regression Results.

Cases Vs. Unmatched Controls

Variable *	Adjusted Odds Ratio	p-value	95% CI for AOR	
			Lower	Upper
Residential proximity, mother after marriage	0.696	0.496	0.246	1.972
Residential proximity, father	0.992	0.987	0.354	2.779
Birth Order	1.323	0.294	0.78	2.229
Difficulties in labour	1.214	0.447	0.737	2.000
Birth Asphyxia	**15.737**	**0.000**	6.304	39.287
Neonatal major sickness	**14.417**	**0.000**	3.229	64.366
Abortions in mother	1.140	0.697	0.589	2.206
Still births	2.403	0.087	0.879	6.568
Literacy-mother	**2.229**	**0.018**	1.146	4.333
Handling pesticides	**3.687**	**0.034**	1.103	12.331
Consanguinity	**4.107**	**0.002**	1.677	10.060

* The categories are as used in Table 13, with the 0 representing the reference group

The analysis showed that the mental retardation in this study population is associated with birth asphyxia, major sickness for the child in first year (which included specially convulsive disorders), educational status of the mother, history of frequent handling pesticides and also consanguinity in marriages. Even though the most important variable of our interest was the residential proximity of parents to the pesticide(endosulfan) spraying. The association seen

thus far with abortions and stillbirths is seen obliterated despite the high Odds Ratio of 1.143 and 2.403.

5.2. Stepwise Logistic Regression: With a stepwise logistic regression (Forward LR) these results were reiterated but with a modified result for stillbirths. The Odds Ratio for the statistically significant variables were also seen altered a bit. The details are given in the following table:

Table :15- Results of Stepwise Logistic Regression (ForwardLR)

Cases Vs. Unmatched Controls.

Variables	Odds Ratio	Sig.	95% Conf. Interval	
			Lower	Upper
Birth Asphyxia	**16.920**	**0.000**	6.958	41.146
Major Neonatal Sickness	**14.733**	**0.000**	3.357	64.660
Stillbirths	**2.837**	**0.034**	1.081	7.448
Pesticide Handling	**4.121**	**0.019**	1.262	13.459
Consanguinity in marriage	**4.254**	**0.001**	1.785	10.143
Literacy- mother	**3.033**	**0.000**	1.662	5.535

5.3.Multivarizte analysis for the paired data:

We did multivariate analysis for the age and sex pair matched controls (n = 189) as well, using multivariate conditional logistic regression using Epi. Info and the adjusted odds ratio arrived at. The results are given below in table 16.

Thus the final results for the logistic regression shows that four variables, difficult deliveries, birth asphyxia, educational status of father, and the most important one, residential proximity of mother after marriage, when adjusted for all other factors, shows an association with mental retardation. The adjusted odds ratios are statistically significant also. The residential proximity factor supports the perception that the aerially sprayed pesticide,

endosulfan has got a definite role in the abnormal diseases seen among the exposed population of Kasargode district, Kerala.

Table 16. Results of Conditional Logistic Regression of Paired Data. (N=189 pairs)

Variables	Adjusted Odds Ratio	95% CI for AOR	p-value
Abortions	1.12	0.29-4.25	0.860
Birth Asphyxia	**16.88**	1.82-156.00	**0.012**
Birth Order	1.99	0.62-6.35	0.243
Consanguinity	3.46	0.62-19.28	0.156
Delivery problems	**4.03**	1.28-12.66	**0.016**
Educational status father	**12.77**	4.09-39.82	**0.000**
Educational status mother	1.45	0.57-3.70	0.431
Pesticide handling	4.78	0.34-66.40	0.243
Residential proximity- mother after marriage	**6.13**	1.05-35.73	**0.043**
Stillbirths	9.43	0.81-108.78	0.070

Chapter. 6. Summary and Discussion

The objectives of this study was to do a geographical mapping of the people with mental retardation and physical deformities in Kasargode district of Kerala State and to do a case control study of the mental retardation with reference to the pesticide exposure. The available secondary data from various government departments was used for the purpose [16]. Exact localization of individual cases was not possible with the constraints of the study. But spatial mapping of the location of government owned cashew plantations in the district spread over more than 4000 hectares of government land lying spread in 11 panchayaths [17] was done as a first step. The prevalence per 1000 population of mental retardation and physical deformities calculated was found to have higher readings in panchayaths having the plantations compared to others. Data pertaining to the deformities was not available for some of the panchayaths and in such cases the aggregate for each block had to be used. The reliability of these data has to be acknowledged under the background that these were prepared by house to house survey by the workers of the Social Welfare Department of the government of Kerala, and later confirmed by the district level medical expert committees specially constituted for issuing certifications for future welfare assistance. The investigator, on sub sample cross checking (n=5) could not find any disparities in case definitions. The prevalence data also suggests the possibility of higher risk of physical deformities, especially in the plains, lower down the site of the plantations. These observations appears to be logical because of the fact that much of the sprayed chemicals seeps down the valley through multitudes of brooks originating from the hill tops, and traverses the length and breadth of the district. There is an apparent linkage with the altitude of these plantations and the

residential areas in these villages, which is located down the valleys. The slopes of the hills, the watershed pattern, the amount of rainfall, the temperature in the area, all has role in dissemination of the sprayed aerosols. The colour plates generated through Epi Info incorporating the above data suggests that there is a possible linkage between the site of the plantations and health outcomes, but need further exploration as to the exact localization of the cases, which is possible only with the help of Geographic Positioning and Remote sensing methodology, which will take more time and resources.

The case control study design was a real challenge in this study. Apart from the selection of cases, the mode of selection of controls was done with much discussion with various experts. Age and sex matched controls was selected in the first phase by the same data collector, from the same village ensured that there is no deliberate selection of controls from a far off place resulting into an artificial control group, and in the second phase a set of unmatched controls were selected by another set of data collectors. During the analysis also this two groups of controls gave almost uniform results, leading to an unequivocal conclusion.

The sex distribution of the study subjects were almost in equal proportions, except that among cases there was a slight male predominance (56 percent males against 44 percent females). The apparently higher percent of females in the unmatched controls (60 percent females against 40 percent males) is to view with the liberty given to the data collectors, who were exclusively women, to select a healthy control from the vicinity of their duty station, at random, without any specification except the age limit. The data collectors and the parents of the study subjects were blinded as to the relationship between the pesticide spraying and the suspected outcomes so as to avoid the recall bias to maximum possible extend. The word

'Endosulfan' was avoided in consent form as well as in the questions related to the predictor variables. In the final result of analysis of the unmatched controls, the residential proximity of mother after marriage to the pesticide sprayed plantations is significantly associated with mental retardation of their children (odds ratio of 2.83 with a p-value of 0.038). The strong association seen with handling pesticides in case of both matched and unmatched controls (odds ratio of 4.121 with p value 0.019 for unmatched controls and OR of 5.3 and p value of 0.004 for matched controls) deserves further exploration. It can be viewed as an indication of a possible relationship, which is getting masked due to other factors like obstetric and neonatal asphyxia. Consistent and significant associations were seen relating mental retardation with birth asphyxia and neonatal major sickness. This observation could also indicate an inadequate obstetric care infrastructure. Along with the relatively poor female literacy (26.2 percent illiteracy among mothers in the study sample in comparison to <10 percent for Kerala State) [18], infrastructure inadequacy for better obstetric care is prone to augment the birth asphyxia which itself can cause all developmental problems for the child.

Statistically significant associations were seen with history of abortions and stillbirths when analyzed for cases against unmatched controls, even though one of it, the abortion variable, got discarded when controlled for other factors in logistic regression. The observation need to be taken as relevant since there are reports of adverse effect of pesticides on developing embryos under experimental situations[19] as well as full term human fetuses.[20, 21,22] The affinity of organochlorine pesticides towards the Adipose tissue makes women more vulnerable to its ill effects.

The results of the variable, pesticide handling, were thought provoking. The questions asked for ascertaining the pesticide handling was non specific and general, covering

commonly used pesticides, but the responses, though small in number (21 in cases and 4 in controls), were mostly related to endosulfan aerial sprays falling on their body while doing outdoor works or involved in collie works related to the preparation of the pesticide mixture for spraying. The fact that these responses were not resulting from any prompting by the data collector suggests minimal recall bias and adds to the strength of suspicion of a definite role for pesticides in the outcome variable.

Consanguinity in marriages, though obscured in the final multivariate logistic regression of the paired controls, is seen as an important risk factor in this study. The cultural practice of consanguineous marriages is an age old phenomena in many communities in India. It is also well known fact that many diseases run in families perpetuated by this type of blood relationships, even though data regarding hereditary illnesses in families of either parents in this study has not shown any significant association. This study also reiterates the need to make communities aware of such possible linkages.

There are few issues to be highlighted regarding the exposure measurements in this study. The residential proximity of parents to the source of the exposure is considered by some researchers as not a refined method of exposure measurement, but it has been used in similar epidemiological studies under resource constrained situations.[23] This method is bound to have some subjective variations, but in our study we suggested the data collectors to reach a fairly uniform assessments, in consultation with the head of the household or a knowledgeable neighbour. Secondary data regarding concentration of endosulfan in different environmental elements such as soil and water collected from different places of this district is available with different agencies, but they are all clouded in disputes. Estimation of blood concentration of the chemical in the study subjects would have helped, but resources were

not favorable for such an effort. The study design and the overall response rate were sufficient to arrive at a statistically significant conclusion.

Limitations of the study:

This dissertation study was a search for a possible association between the much debated aerial pesticide spraying and alleged health outcomes including mental retardation and physical deformities in Kasargode district of Kerala. The use of secondary data for planning the study as well as the mapping is probably one of the most important limitations of this study. These data, prepared by one of the government department appears incomplete, but the validity of the available data is good. Secondly, the exposure measurement by way of residential proximity of parents, though used in other studies elsewhere, might appear crude. But in a resource constrained studies, it could be taken as the only option.

Chapter .7.Conclusions and Recommendations

This study, leaving aside the inherent issues of design, has come out with good evidence of an association between chronic exposure to organochlorine pesticide, endosulfan and one of its suspected health impact namely neurophysiological defects in humans. Out of the forty-five different variables studied, four variables have come out as prominent associated risk factors. They are birth asphyxia, difficult labour, educational status of fathers and residential proximity of mothers to the endosulfan aerially sprayed cashew plantations. The first two had been known risk factors, but the last was always a disputed one. All throughout the analysis of the current data, there was indication of such a relationship that was confirmed only n the final stage of multivariate logistic regression of the paired data, thus justifying the whole exercise. The results reiterates the belief that women are at higher

risk of adverse impact from pesticides, since many reproductive effects like repeated abortions and still births also figured among the risk factors. The effects of exposure were more marked in women residing closer to the sprayed plantations than men. This could be due to the fact that most of the organochlorine chemicals has got affinity towards adipose tissue. Insufficient obstetric care to the rural women of the district was another striking observation of the study, which accentuated the already endangered scenario and remedial actions are urgently called for in light of these observations. Consanguinity and lowered educational status needs social actions as well.

The study results bears several policy implications. In view of the evidence showing an association between the pesticide spraying and health outcome, the temporary ban imposed on the pesticide spraying need to be continued till more studies proves contrary results. A prospective cohort study to identify long-term impact could be planned and executed with technical support from academicians, but the validity of such studies if the pesticide is totally banned is also an issue to be anticipated. A similar study with the outcome variable as birth malformations can be done, so as to supplement and widen the evidence base. But in a socially charged situation like the one present in this district, where any demand for scientific evidence is seen as an insult to the suffering community, long term studies will be a real challenge. Remedial and rehabilitation of the affected community undertaken simultaneous to research might be a good option. Search for detoxifying the environment has also to be thought of. The infra structure facilities and technical capability of service providers in the field of obstetric care in the district need to be improved with utmost urgency. Functional literacy programs need to focus more on the affected segments so also the community has to be made aware of the rare consequences of consanguineous

marriages. The district is an ideal setting for all pesticide related research and rehabilitaion efforts.

References:

1. *Fact Sheets on Endosulfan*- Centre for Science and Environment (CSE) New Delhi, Thanal- Environment Conservation Network, an NGO based at Trivandrum.

2. Alsopp M. Strogu R, and Johnson P- *Unseen poisons,Levels of Organochlorine pesticides in human tissues* –Greenpeace.
3. Endosulfan fact sheet – different websites

4. Elina Maria Celis- A *Chilean study on pesticides and health impact*- web article

5. NRDC, *The Story of Silent Springs* http://www.nrdc.org/health/pesticides/hcarson/asp accessed on 17-3-2005.

6.Endosulfan –Press release by CSE New Delhi: cse.htm.dted 8-2-2005.

7. *Disclosed*-Cover story on Endosulfan; Down t9o Earth,vol.12 No.22,April 2004,p20-29.

8. Verdict on Hon. High Court of Kerala, in case of Thiruvankulam Nature lovers movement vs. Plantation Corporation of Kerala as per OP Nos.20716/2002,29371/2001 and 16300/2002 dt 8-12-2002.

9. USEPA; *About Pesticides,* updated 21 July 2005; url.http//www.epagov/pesticides.about.

10. *Solid Organochlorines* ; npc.orst.edu/RMPP/rmpp. Chapter.6.accessed on 15-10-2005.

11. B.Botella, J.Crespo, A. Rivas et al-*Organochlorine pesticides in Southern Spain*. Envirn.Res.96 (1) 2004 34-40.

12. Archebaque, Engel SL, Tessazi JD et al, *1997Comparison of Organochlorine pesticides and polychlorinated biphenyl residue in human breast adipose tissue and serum*. J.Toxicol.Envirn.Health,52,285-293.

13. Cocco.P, Kazerouni N, Zafun S. 2000,*Cancer mortality and environmental exposure to DDE in United State,* Environ. Health. Perspect 108; 1-4.

14. Eric Weltman, The Greens/Green party senator, USA, *Synthesis/Regeneration* 7-8, Summer 1995.

15. Theo Colbom, Frederick.S.vom sal, and Ana M. Solo, *The developmental effects of endocrine disrupting chemicals in wild life and humans,* Environ.Health.Perspect.101 (5) 378-384 October 1993.

16. Sara Sexton; *The Reproductive Hazards of Industrial chemicals,* The Ecologist, Nov-Dec 1993 p 212.

17. Zonghua Yu Fung,Yi Xua Za Zhi, 1999 July 33 (4)228-230. *Risk factors of Cerebral palsy in children* (Abstract only-original article in Chinese)

18. Lis.A. Croin, Judith KG, Steve Sulvun- *Epidemiology of mental retardation in children, of unknown causes.;* Paediatrics, vol(10) No.6,June 2001,p.86.

19. Bryan H. King, RM Hadyp, Elizabeth M Dyken; chapter on Mental retardation,in Kaplan and Sadock's Comprehensive Text book of Psychiatry, 7th Edn, Pub-LippincottWilliams and Wilkins, pp 2593-2594.

20. Yahoon M, Bashir A, Zaman S et al, *Mild Intellectual disability in Children of Lahore,* Pakistan-Etiology and risk factors. J. Intellect.Disabil. 2004 Oct, 48 pp 663-671.

21. Report submitted by the District Medical Officer, Health, to the Director of Health Services, Kerala State, as per documents ak/18/07 and ak/07/01.

22. H. Syed, A.Dewan et al, *Effect of Endosulfan on male reproductive development,* Childrens' Health Article in Environ.Health.Perspect.vol 1111 No. 161, Dec 2003,pp 1958-1961.

23. Romeo F Quijano, *Endosulfan Poisoning in Kasargode district of Kerala, India,* report of a fact-finding mission, personal communication from 'Thanal', Conservation Action and information Network, Trivandrum.

24. Helen H Mc Duffie, Punam Pahwa, et al, *Non Hodgkins lymphoma and specific pesticide exposure in men;* Cancer Epidemiology Biomarkers and prevention, vol 10,1155-1163 Nov 2001.

25. Dina M Schreinemacher; *Birth Malformations and other adverse perinatal outcomes in four US wheat producing states,* Environ.Health.perspect.vol 111 (9) July 2003.

26. Raman Kutty, Sara Abraham and CC Kartha; *Geographical distribution of Endomyocardial fibrosis in South Kerala,* International Journal of Epidemiology, vol 25,no.6,p 1202-1206.

27. Keith C Clarke, Sara L Mc Lafferty and Barbara J Tempalski, Hunter College New York: *Perspectives on Epidemiology and Geographical Information System*;

A review and discussion of future directions; Emerging Infectious diseases vol. 2, no.2, April-June 1996.

28. Directory of the disabled persons in Kasargode district, Kerala, published by District panchayat Kasaragode, Ed. VPP Musthafa, 2003-2004.

29. Personal communications from Mr.Narayanan Peria, Chairman of the Anti endosulfan campaign committee, Kasargode.

30. Census-2001, Kerala.

31. Kogvinas M, Saki M, 1998. *Pesticides and congenital malformations. How many studies will it take to reach a conclusion?* Scand.J.work Environ.Health; 24:445-447.

32. Kristensen P, Irgens LM, Andersen A, Bye AS, Sundheim L 1997. *Birth defects among offsprings of Norwegian farmers 1967-1991*, Epidemiolgy,8: pp537-544.

33. Hanify JA, Metcaff P, Nobbs CL, Worsle KJ, 1981, *Aerial spraying of 2,4,5-T and human birth malformations-an epidemiological investigation,* Science 212: pp349-351.

34. Anna Karin Hurtig, Miguel San Sebastian; *geographical differences in Cancer incidence in the Amazon basins of Ecuador in relation to residence near the oil fields;* Intern.Jor.of Epidemiolog, 2002: 31; 1021-1027.

35. Chitra KS, Lakchoumycannc C, Mathur PP; *Chronic effect of endosulfan on testicular functions of rats,* Asian J. Androl.Dec 1999,I, pp 203-206.

*****

Appendix 1

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

Public Health Division of Sree Chitra Tirunal Institute for Medical Sciences and Technology.

Trivandrum, Kerala, India. 695011

INTERVIEW SCHEDULE

Research Topic: Study on Mental Retardation among 0-24 age group, in Kasargode district, Kerala.

A. Consent:

The information intended to be collected through this questionnaire are part of a study about mental retardation seen among many people in this part of Kasargode district. Dr. Sukumaran, MPH Scholar of 2004 batch of this Institute is the designated officer for this study. The information thus collected will be kept strictly confidential and will be used only for research purposes. The information will be collected about the study subjects and also their close relatives. There will not be any risks or discomforts involved in participating in this study. Although there is no immediate benefit for you out of this study, your community as a whole might benefit later. You are free to disagree to take part in the study and your reluctance will not affect you in any way whatsoever. I shall stop the interview if in between the process you feel like unwilling to continue. But being a subject of great public health importance, if you have understood what is told here, I humbly request you to give consent for participating and giving all relevant information.

Consented ..... Subject/Parent/Caregiver/Guardian.

Interviewer .....

Principal Investigator:

Dr.A.Sukumaran.
B.Sc, MBBS, D.Ortho,
MPH Scholar, 2004,SCTIMST, Trivandrum.
Contact Phone:09847600137.

Sl. No..... Subject No..... Household No..... Village.....Panchayath…...

(This segment will be masked after data collection to ensure confidentiality)

A. Demographic Information.

1. Name of the subject .....
2. Name of the Parent .....
3. Age of the subject (As reported by parent).....
4. Sex.....
5. Age of Mother.....
6. Age of father.....
7. Illness Category: Codes
   - a. Mental Retardation 1
   - b. Physical Deformity 2
   - c. Both 3 ☐
   - d. None 4
8. Educational level of mother;
   - a. Primary (completed or below 7 std.) 1
   - b. Secondary (completed or below 10 std) 2
   - c. Above Secondary (above 10^{th}) 3
   - d. Illiterate 0 ☐
9. Do you belong to above poverty group or BPL?
   - a. Above poverty 1
   - b. Below poverty 2 ☐
10. What type of salt do you use for cooking at home?
    - a. Common salt -1
    - b. Refined Iodine added salt. -2 ☐
11. Occupation of mother Before marriage: .....
    - Domestic duties - 1
    - Agriculture/Farm works - 2
    - Labourer in Cashew estate - 3
    - Office/School works - 4 ☐

Others (specify……) - 5

12. Occupation of mother after marriage: .....

Domestic duties	1
Agriculture/Farm works	2
Labourer in Cashew estate	3
Office/School works	4
Others (specify……)	5

13. Birth Order for this child.

1. First -1
2. Second. -2
3. Third -3
4. Four and above. -4

14. Have you had any abortions?

a. Yes. - 1
b No. - 0

14. If yes give numbers.

a. Once - 1
b. More than once. – 2

15. Did you ever have a Stillbirth?

a. Yes. - 1
b. No. - 0

16. If yes, how many times?

a. Once. - 1
b. More than once - 2.

17. Type of delivery:

a. Home, unassisted. - 1
b. Home assisted by local Dai - 2
c. Hospital, Normal. - 3
d. Hospital, Caesarian. - 4

18. Was there any problems during delivery like,

a. Delay of > 24 hours after onset of pain. - 1

b. Bleeding before delivery. - 2

c. Delivery before completing 8 months . - 3

d. Multiple babies. - 4

e. Convulsions for the mother. - 5

f. No problems - 6

19. Did the child cry immediately after birth.

a. Yes. - 1

b. No. - 0

20. If No, how long after

a. Within first half hour. - 1

b. After half hour. - 2

21. Any severe illness for the child in first year.

a. Yes. - 1

b. No. - 0

22. If yes, what type

a.....

b..... (Get mother's version)

23. Did you have any illness during this child's pregnancy?

a. Yes - 1

b. No. - 0

24. If yes, what

.....

.....

…….....(Probe for type esp. in first three months.)

25. Did you take any drugs during the first three months of this pregnancy?

a. Yes - 1

b. No. - 0

26. If yes, details if possible.

.....

.....

27. Is there any hereditary diseases in your family

a. Yes. - 1

b. No. - 0

28. If yes, what .....

.....

29. Is there any health problems for your other children

a. Yes. - 1

b. No. - 0

30. If yes, details.

a. For the first child .....

b. For the second child .....

c. For the third .....

31. How close is your house to the pesticide sprayed Cashew plantations (Before marriage)

a. Within one kilometer. - 1

b. Within 5 km. - 2

c. Beyond 5 kms. - 3

33. How close is your house to the above-referred area after marriage.

d. Within one kilometer. - 1

e. Within 5 km. - 2

f. Beyond 5 kms. - 3

34. What is the drinking water source for the family?

a. Shallow well. - 1

b. Public tap. - 2

c. Pond/river/Brookes. - 3

35 . Are there any Chemical factories near to house, own/spouses?

a. Yes. - 1

b. No. - 0

36. If yes, details.....

37. Do you have any of the following personal habits?

a. Tobacco smoking: Yes/No 1

b. Alcohol : Yes/No 2

c. Tobacco chewing: Yes/No. 3

d. All of them 4

e. None of them. 5

37. Educational level of father of the subject.

a. Primary (completed or below 7 std.) - 1

b. Secondary (completed or below 10 std) - 2

c. Above secondary. - 3

d. Illiterate - 0

38. Occupation of father before marriage .....

a. Farming/agriculture. - 1

b. Coolie works. - 2

c. Office/School. - 3

d. Labourer in the Cashew plantation. - 4.

e. Others ……(specify).. - 5

39. Occupation after marriage.....

. a. Farming/agriculture. - 1

b. Coolie works. - 2

c. Office/School. - 3

d. Labourer in the Cashew plantation. - 4.

e. Others……(specify).. -5

40. Does the father of the study subject has any of the following personal habits?

a. Smokes daily Yes/No 1

b. Chews daily Yes/No. 2

c. Uses alcohol daily. Yes/No 3

d. All of them 4

e. None of them 5

f. Others……

41. Is there a history of any hereditary illnesses in father's family?

a. Yes. - 1

b. No. - 0

42. If yes, details.....

43. Proximity of fathers' house to the pesticide sprayed plantations, before marriage.

a. Within 1 km. - 1

b. Within 5 kms. - 2

c. Beyond 5 kms. - 3

44. Proximity of your house to pesticide sprayed area after marriage.

a. Within 1 km. - 1

b. Within 5 kms. - 2

c. Beyond 5 kms. - 3

45. Did the mother/father have any illness lasting for > one year.

A. Mother	B. Father
a. Yes. - 1	a. Yes
b. No. - 2	b. No.

46. If yes, what .....

a. Mother…… b. Father

47. How long have you been staying in this place/house?

a…….(No. Of years)

48. Have you stayed anywhere else?

a. Yes b. No.

49. If yes, was that place close to the Pesticide sprayed Cashew plantations?

a. Yes. b. No.

47. Have you been ever exposed to any pesticides?

a. Yes. - 1

b. No. - 0

48 If yes, details.....

49. Date of birth of this child/person: ……..

(If not available get the month, at least,)

50. Was the mother and father of the subject relatives (blood relatives) prior to their marriage?

1. Yes - 1

b. No. - 0

Verify whether all columns are filled up, and if any remains blank, check and complete.

Express thanks for co-operation and close the interview.

Date……. Name and Signature of Data collector.