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Fish Consumption and Human Health

A Clinico-epidemiological Study

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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Nutrient Profiling and Evaluation of Fish as a Dietary Component

Outreach Activity # 3

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Bulletin No. 177 **February 2014**

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FOREWORD

Fish is one of the important sources of quality proteins and plays an important role in preventing protein calorie malnutrition. Fish oils are rich in PUFAs, especially the omega-3 fatty acids EPA and DHA, which are effectively being used in nutraceuticals for preventing coronary diseases, osteoarthritis, dementia, age related macular degeneration, asthma and depression. The small indigenous fishes are micronutrient dense and majority of micronutrients required are fulfilled by consuming these fishes.

There is a direct relationship of health with fish consumption. Higher fish consumption especially the marine fishes is also reported to be associated with low incidence of 'low birth weight'. A correctly designed survey is an ideal tool for collecting and evaluating data. In this context, clinic epidemiological studies (CLEPS) are important to correlate the impacts of fish consumption on human health. Besides such surveys, it is also important to conduct feeding trials to have first hand clinical information from the experts. Such studies are being conducted under ICAR Outreach Activity on 'Nutrient Profiling and Evaluation of Fish as a Dietary Component'

It is expected that this bulletin on "Fish Consumption and Human Health: A Clinico Epidemiological Study" brought out under ICAR Outreach Activity, would provide a broad overview on the role of fish consumption on human health. The questionnaire, developed with help of experts, can be used by other researchers interested in carrying out similar studies.

The authors deserve appreciation for their efforts in generating and documenting valuable information.

(S. Ayyappan)

Dated the 26th February, 2014
New Delhi

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FOREWORD

Fish, being a rich source of quality animal proteins, essential fatty acids and micronutrients, is serving as a natural supplement for essential nutrients to a vast majority of population belonging to different socio-economic status in the developing and under developed countries. Fish is a low-fat high quality protein. It is filled with omega-3 fatty acids and vitamins such as D and B2 (riboflavin) and also rich in calcium and phosphorus and a great source of minerals, such as iron, zinc, iodine, magnesium, and potassium. Fish plays a major role in preventing many human ailments including coronary diseases, age-related macular degeneration, mental illness, eye diseases, low birth weight and micronutrient deficiencies. Researchers worldwide have discovered that eating fish regularly may reduce the risk of diseases ranging from childhood asthma to prostate cancer.

The health benefits of eating fish is long been known and many commercial products such as omega-3 tablets and fish oil enriched food products are being prescribed by physicians. Worldwide surveys and studies are now being carried out to scientifically establish the perceived health benefits of eating fish.

I appreciate the efforts of the authors of this bulletin for bringing out the scientific facts related to health benefits of eating fish "Fish Consumption and Human Health - A Clinico-epidemiological Study" as part of the ongoing ICAR Outreach Activity on 'Nutrient Profiling and Evaluation of Fish as a Dietary Component'. This bulletin is expected to add to the present understanding of health benefits of eating fish and will be instrumental in popularising fish as a health food.

B. Meenakumari

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Dated 26th February, 2014

FOREWORD

The medicinal and therapeutic values of fish are well known and are being harnessed for preventing a wide range of human ailments. However, during the last few decades serious efforts have been made for scientifically establishing the health benefits of eating fish through clinico-epidemiological surveys and human feeding trials. This bulletin has documented valuable information on conducting surveys and has also added new scientific information on health benefits of fish consumption through clinico-epidemiological surveys. Fish consumption has been correlated with low incidences of 'low birth weight' among the marine fish eating population. The Questionnaire format for the survey would be useful for others involved in such studies and the information generated would be helpful for the consumer guidance.

I appreciate the efforts of the authors for bringing out the valuable information on health benefits of eating fish in form of this bulletin "Fish Consumption and Human Health - A Clinico-epidemiological Study" under the ICAR Outreach on "Nutrient Profiling and Evaluation of Fish as a Dietary Component".

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Contents

Fish Consumption and Human Health
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Fish is an important part of the diet of human in almost all the countries of the world. Animal proteins are generally superior to plant proteins and fish is one of the cheapest sources of quality animal protein and availability and affordability is better for fish in comparison to other animal protein sources. Fish serves as a health food for the affluent world owing to the fish oils which are rich in polyunsaturated fatty acids (PUFAs), especially the omega-3 PUFAs and at the same time, it is a health food in the other extremes of the nutritional scale owing to its proteins, oils, vitamins and minerals and the benefits associated with the consumption of small indigenous fishes.

Health Benefits of eating fish

Preventing protein calorie malnutrition

Two forms of child undernutrition Kwashiokor (chronic protein deficiency) and marasmus (chronic deficiency of calories), often occurring together are world health problems, In this context, fish, being one of the cheapest sources of quality animal protein, is playing a big role and can still play a bigger role in preventing the protein-calorie malnutrition.

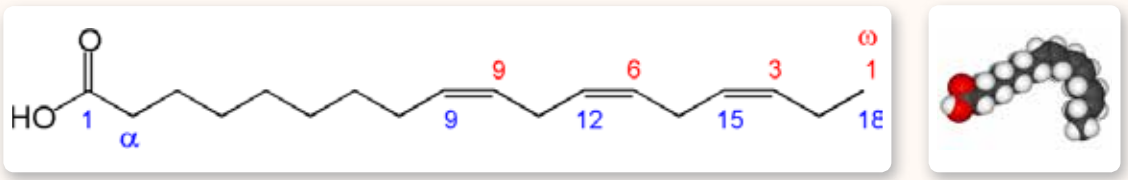
Protein calorie malnutrition (PCM) is a potentially fatal body-depletion disorder. It is the leading cause of death in children in developing countries. PCM is also referred to as protein-energy malnutrition. It develops in children and adults whose consumption of protein and energy (measured by calories) is insufficient to satisfy the body's nutritional needs. While pure protein deficiency can occur when a person's diet provides enough energy but lacks the protein minimum, in most cases the deficiency will be dual. PCM may also occur in persons who are unable to absorb vital nutrients or convert them to energy essential for healthy tissue formation and organ function. Kwashiorkor and marasmus are the extreme conditions of PCM, mostly found in children, caused due to lack of protein and energy. Kwashiorkor results from a chronic deficiency of protein, whereas marasmus is caused by a chronic calorie deficiency and along with protein insufficiency. In kwashiorkor, early symptoms include fatigue, irritability and lethargy. As protein deprivation continues, growth failure, loss of muscle mass, generalized swelling (edema) and decreased immunity can be observed in the patient. A large, portubernt belly is common in those having the disease. On the other hand, marasmus is characterized by growth retardation in weight more than height so that the head appears quite large relative to the body. There is a progressive wasting of subcutaneous fat and muscle (emaciation) so that skin appears loose. Severe prolonged marasmus may result in permanent retardation. PCM also occurs in adults who are under chronic nutritional deficiency.

Fish as rich source of essential fatty acids

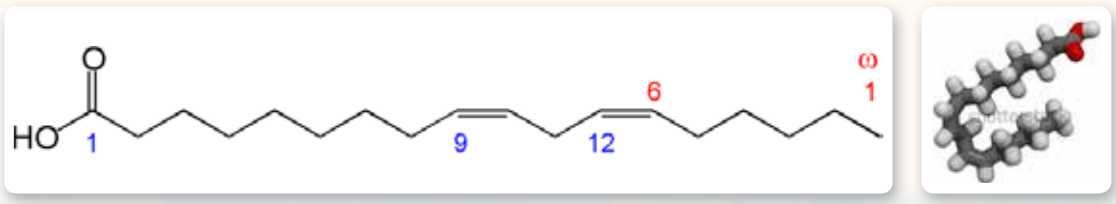
Fish serves as a health food for the affluent world owing to the fish oils which are rich in polyunsaturated fatty acids (PUFAs). PUFAs include the essential fatty acids, viz. α- linolenic acid (18:3, n-3, ALA) and linoleic acid (n-6 fatty acid) which are highly important for human health (Fig - 1). They are the starting point for the formation of long chain PUFAs (LC-PUFAs) like eicosapentaenoic acid (20:5, n-3, EPA) and the docosahexaenoic acid (22:6, n-3, DHA). The human body cannot synthesize n-3 fatty acids de novo, but it can form 20-carbon unsaturated n-3 fatty acids (like EPA) and 22-carbon unsaturated n-3 fatty acids (like DHA) from the eighteen- carbon n-3 fatty acids α- linolenic acid. These conversions occur competitively with n-6 fatty acids which are chemical analogues derived from linolenic acids. Both the n-3 α- linolenic acid and n-6 linoleic acid are essential nutrients which must be obtained from food (Kris- Etherton *et al,* 2000). Synthesis of the longer n-3 fatty acids from linolenic acid within the body is competitively slowed by the n-6 analogues. Thus accumulation of the long-chain n-3 fatty acids in tissue is more effective when they are obtained directly from food or when competing amounts of n-6 analogs do not greatly exceed the amounts of n-3 (Hibbeln *et al,* 2006).

Essential fatty acids, or **EFAs**, are fatty acids that humans and other animals must ingest because the body requires them for good health but cannot synthesize them. The term "essential fatty acid" refers to fatty acids required for biological processes, and not those that only act as fuel (Modern Nutrition in Health and Disease).

Only two EFAs are known for humans: alpha-linolenic acid (an omega-3 fatty acid) and linoleic acid (an omega-6 fatty acid).

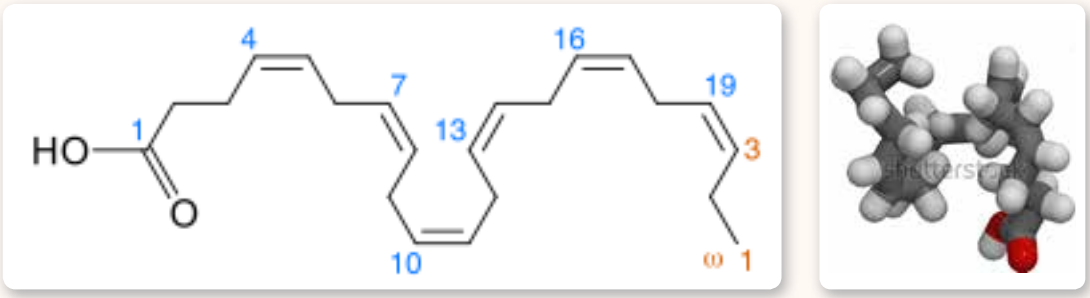


α-linolenic acid (ALA), an essential n–3 fatty acid



Linoleic acid, an essential n-6 fatty acid

Eicosapentaenoic acid (EPA)



Docosahexaenoic acid (DHA)

Fig 1: Chemical and three dimensional structures of some PUFAs

The LC-PUFAs that belong to the ω-3 family i.e. EPA and DHA have a number of neutraceutical and pharmaceutical applications. EPA and DHA are known to reduce the risk of coronary heart diseases, protect against diabetes mellitus and exhibit anti-inflammatory actions (Table 1). They also play a crucial role in the treatment of atherosclerosis, cancer, rheumatoid arthritis, psoriasis and diseases of the old age such as Alzheimer's disease and age-related macular degeneration (AMD). Fish oil's are the major sources of PUFAs, and considerable evidence has indicated that n-3 or ω-3 PUFA in fish oils are actually derived via the marine food chain zoonplankton consuming ω-3 PUFA-synthesizing micro-algae. The most widely available source of EPA and DHA are oily fishes such as hilsa (Mohanty *et al,* 2012), salmon, herring, mackerel, anchovies and sardines and cold water fishes like trout mahseer (Fig - 2 and Fig - 3). Oils from these fish have a profile of around seven times as much n-3 as n-6. Other oily fish such as tuna also contain n-3 in somewhat lesser amounts.

Like n-3 fatty acids, n-6 fatty acids (such as γ-linolenic acid and arachidonic acid) play a similar role in normal growth. n-6 is "better" at supporting dermal integrity, renal function, and parturition (Calder, 2008). The biological effects of the n-6 fatty acids are largely mediated by their conversion to n-6 eicosanoids that bind to diverse receptors found in every tissue of the body. The conversion of tissue arachidonic acid (20:4n-6) to n-6 prostaglandin and n-6 leukotriene hormones provides many targets for pharmaceutical drug development and treatment to diminish excessive n-6 actions in atherosclerosis, asthma, arthritis, vascular

disease, thrombosis, immune-inflammatory processes and tumor proliferation. Some medical research suggests that excessive levels of n-6 fatty acids, relative to n-3 fatty acids, may increase the probability of a number of diseases and depression. Chronic excessive production of n-6 eicosanoids is associated with heart attacks, thrombotic stroke, arrhythmia, arthritis, osteoporosis, inflammation, mood disorders and cancer. Many of the medications used to treat and manage these conditions work by blocking the effects of the potent n-6 fatty acid, arachidonic acid. The cyclooxygenase COX-1 and COX-2 inhibitor medications, used to treat inflammation and pain, work by preventing the COX enzymes from turning arachidonic acid into inflammatory compounds (Calder 2008). Many of the anti-mania medications used to treat bipolar disorder work by targeting the arachidonic acid cascade in the brain. Linoleic acid (18:2, n-6), the shortest-chained n-6 fatty acid, is an essential fatty acid. Arachidonic acid (20:4) is a physiologically significant n-6 fatty acid and is the precursor for prostaglandins and other physiologically active molecules.

Fish and seafood are the richest source of n-3 polyunsaturated fatty acids in nature and consumption of fish containing high levels of long chain n-3 PUFAs improves human health and nutrition (Ruxton *et al,* 2007). The beneficial effects of n-3 fatty acids on health are generally accredited to oils from marine species but the lipids from migratory species like *Tenualosa ilisha* can also serve as a valuable source of essential fatty acids as they contain substantial concentration of n-3 fatty acids. The fish is endowed with valuable fatty acids and lipids which play a major role in providing pharmaceutical elements for physiological maintenance of body tissue. Polyunsaturated fatty acids, EPA and DHA especially obtained from fish oil are reported to be potent in reducing risk of coronary heart diseases, stroke, hypertension, cardiac arrhythmias, diabetes, rheumatoid arthiritis, brain development, cancer and depression (Mohanty *et al*, 2012, Alam *et al,* 2012). Fish especially saltwater fish is high in omega 3 fatty acids which are heart friendly and is conjectured to be one of the major causes of reduced risk of cardiovascular diseases in Eskimos (Bang *et al,* 1976).

Sardinella longiceps

Rastralliger kanagurta

Thunnus albacores

Thunnus thynnus

Nemipterus japonicus

Ketsuwonus pelamis

Nemipterus japonicas

Leiognathus splendens

Fig 2: Marine fishes rich in omega-3 PUFAs

Oncorhynchus mykiss

Tor putitora

Schizothorax richardsonii

Neolissochilus hexagonolepis

Fig 3: Coldwater fishes rich in omega-3 PUFAs

Table 1. Therapeutic value of fish oils (ω3 PUFAs) in human health

Age group/ Population	Prevents
Adult	Cardio-vascular disease (CVD Hypertension Idiopathic oligoasthenoteratozoospermia
Geriatric	Dementia Age-related macular degeneration (AMD) Alzheimer's disease (AD)
Pediatric	Childhood asthma Attention deficit hyperactivity disorder (ADHD)

Lack of essential fatty acids also causes behavioral problems in the pediatrics population which is known as Attention Deficit Hyperactivity Disorder (ADHD) (Fig - 4). Children suffering from ADHD are inattentive, impulsive and hyperactive (Antshel *et al,* 2011). Studies have reported that children with ADHD had significantly lower levels of arachidonic acid, eicosapentaenoic acid (EPA) and docosahaxaenoic acids (DHA) in their blood and these hyperactive children suffer more from symptoms associated with essential fatty acids deficiency (thirst, frequent urination, dry hair and skin) and are more likely to have asthma and studies have suggested that long term fish oil supplementation may reduce asthma severity in these cases (Hung *et al,* 2009).

Fig 4: Attention Deficit Hyperactivity Disorder (ADHD)

(Source:http://drugster.info/ail/pathography/995/)

(Source:http://www.cracked.com/funny-3093-addadhd/)

Role of fish in micronutrient deficiency

The small indigenous fishes (the freshwater species which grow to a size of about 25-30 cm in matured or adult stage) which are micronutrient rich are mainly consumed by the rural people as they get it easily by catch and therefore get the associated health benefits (Roos *et al,* 2003). The small indigenous fishes are prolific breeders that need little or no management and can grow in the backyard ponds, derelict water bodies, beels, wetlands etc. therefore, are commonly available in rural areas where such aquatic habitats are common (Fig - 5). Micronutrients are the essential dietary elements that are needed in small quantities which include vitamins and minerals that the body must obtain from outside sources. Micronutrients are required in small amounts as they are either components of enzyme cofactor or act as coenzymes in many biochemical reactions and metabolic processes vital for survival, growth and reproduction. The vitamins include fat soluble vitamin A, D, E, K as well as thiamin, riboflavin and niacin (vitamin B_1, B_2 and B_3) and vitamin C and minerals like copper, iron, zinc, selenium, iodine, magnesium, cobalt, manganese and macro minerals like calcium and phosphorous. Micronutrient deficiency conditions are widespread among two billion people in developing and in developed countries. These are silent epidemics of vitamin and mineral deficiencies affecting people of all genders and ages, as well as certain risk groups. They not only cause specific diseases, but they act as exacerbating factors in infectious and chronic diseases, greatly impacting morbidity, mortality, and quality of life. The small indigenous fishes like *Amblypharyngodon mola* and *Puntius sophore* are rich in micronutrients (Mohanty *et al,* 2013). Vitamin A from fish is more readily available to the body than from plant sources. Among all the fish species, fatty fish contains more vitamin A than from lean species. Studies have shown that mortality is reduced in children under five with a good vitamin A status. Vitamin A is also required for normal vision and for bone growth. The small indigenous fish *Amblypharyngodon mola* is a very rich source of vitamin A as compared to many other species (Kongsbak *et al,* 2008; Mohanty *et al,* 2014). Vitamin D present in fish livers and oils is crucial for bone growth since it is essential for the absorption and metabolism of calcium. It also plays an important role in immune function and may offer protection against cancer, chronic diseases like osteoporosis, cardiovascular diseases, mood disorders and diabetes. Oily fish is the best food source of unfortified vitamin D. Vitamin E is considered as a potent lipid

- An estimated 250 million preschool children worldwide are vitamin A deficient and it is likely that in vitamin A deficient areas a substantial proportion of pregnant women are vitamin A deficient.
- An estimated 250 000 to 500 000 vitamin A-deficient children become blind every year, half of them dying within 12 months of losing their sight (WHO, 2012).

soluble antioxidant. Besides it plays many important physiological roles in oxidation of low density lipids, enzymatic reactions, regulation of gene expression, and growth inhibition of cancer and small indigenous fish like *Puntius sophore* is rich in vitamin E (Mahanty *et al,* 2014).

Amblypharyngodon mola

Puntius sophore

Osteobrama cotio cotio

Esomus danricus

Gudusia chapra

Anabas testudineus

Fig 5: Some nutrient dense small indigenous fishes

Minerals are inorganic nutrients, usually required in small amounts from less than 1-2500 mg per day depending on the type of minerals i.e. macro (major) and micro (trace) mineral. Although they yield no energy, they are essential for normal life processes and fishes are rich source of these nutritionally important minerals (Soetan *et al,* 2010). The minerals present in fish include iron, calcium, zinc, iodine (from marine fish), phosphorous, selenium and fluorine. These minerals are highly 'bioavailable' meaning that they are easily absorbed by the body.

Calcium and phosphorus are essential elements for formation of bones and teeth (formation

and mineralization) and for the normal functioning of muscles and the nervous system. It is also an important component of the blood clotting process. Deficiency of calcium may be associated with rickets in young children and osteomalacia (softening of bones) in adults and older people. Large fish do not contribute to calcium intake because their bones are discarded as plate waste and not eaten but small indigenous fishes are eaten whole with bone, head and eye thereby providing a rich source of calcium and other micronutrients (Kongsbak *et al,* 2008). Although, iron content is less in fish than red meat, iron in white fish is well absorbed and on weight-weight basis, shellfish contains as much iron as lean meat. Iron is mainly required for the synthesis of hemoglobin in the red blood cells which is important for transporting oxygen to all parts of the body. Iron deficiency is associated with anemia, impaired brain function and in infants is associated with poor learning ability and poor behavior. Due to its role in the immune system, its deficiency may also be associated with increased risk of infections.

Zinc is also an important mineral that is required for most of the body processes as it occurs together with proteins in essential enzymes required for metabolism. Zinc plays an important role in growth and development as well in the proper functioning of the immune system and for the healthy skin. Zinc deficiency is associated with poor growth, skin problems and loss of hair among other problems. High-protein food like meat and fish contain the highest amount of zinc and it is also easily absorbed from these sources. Oysters provide more zinc than any other food. Other types of oily fish and seafood such as skates, anchovies, herring, sardines, crab, prawns, shrimps, mussels and winkles also provide a significant amount of zinc as well as giant river catfish *Sperata seenghala* (Mohanty *et al,* 2012).

Iodine is important for hormones that regulate body metabolism and in children it is required for growth and normal mental development. A deficiency of iodine may lead to goiter (enlarged thyroid gland) and mental retardation in children (cretinism). Fish is one of the few reliable sources of iodine. The UK recommendation intake of iodine for adults is 140 *mcg* a day and a 100g portion of some fish can provide all the requirement of iodine for a day. Nutrient profiling of fishes show that fishes have superior nutrients and umpteen number of health benefits are believed to be associated with regular fish consumption.

The health benefits of eating fish are being increasingly understood now. Recently, a $20-million US Government sponsored probe has been launched to examine whether fish oils and vitamin D can help prevent heart disease, cancer and a range of other illness. Oily fish is claimed to help in preventing a range of other health problems from mental illness to blindness. Excessive consumption of red meat is the real killer and if people are eating fish which is quite harmless in itself, it means they are not eating meat. Therefore, their health is bound to benefit. Similarly, there are on-going Govt of India-sponsored projects, running under ICAR and ICMR, which

aim at nutrient profiling of important food-fishes from the Indian waters and also to study the health benefits of eating fish (Mohanty *et al,* 2011, Fishupdate.com).

Maternal fish consumption and low birth weight incidences:

Higher fish consumption is also associated with low risk of low birth weight (<2500gm). Low Birth Weight (LBW) is a major public health issue and is more prevalent in South Asian countries. India, the most populous country in South Asia shares a very high prevalence of low birth weight (Fig - 6). It is home to 42% of the world's underweight children and 30% infants have a low birth weight (Bamji, 2011). Moreover, according to an ICMR study, prevalence of low birth weight ranged between 26-57% in the urban slums and 35-41% in the rural communities (Mohanty 2010). Low birth weight is one of the main causes of high infant mortality rates. Compared to a normal birth weight baby, infant mortality rates are about 12 times higher if a baby weighs less than 2500 gm. Low birth weight and small for dates leads to non-insulin dependent diabetes (NIDD) and cardiovascular diseases (CVD) like high blood pressure, coronary heart disease (CHD) and strokes at the later stage of life which may have their origins at birth.

Low birth weight is defined as weight of less than 2,500 g (2.5 kg) at birth (WHO, 2004).

Fig 6: Low birth weight baby (Source:http://thestutteringbrain.blogspot.in/2009/11/low-birth-weight-doubles-to-triples.html)

Barker hypothesized that the associations between small size at birth or during infancy and later CVD reflect permanent effects of fetal undernutrition. The fetus is dependent on the nutrients from the mother and adapts to an inadequate nutrient supply in a number of ways: prioritization of brain growth at the expense of other tissues such as the abdominal viscera, reduced secretion of sensitivity to the fetal growth hormones insulin and IGF-I, and up-regulation of the hypothalamo-pituitary adrenal (HPA) axis. The fetal onset of adult disease (FOAD) hypothesis proposes that although occurring in response to a transient phenomenon (fetal under-nutrition) these adaptations become permanent or 'programmed' because they

occur during critical periods of early development. The hypothesis is supported by examples in experimental animals of permanent structural and metabolic changes resulting from transient nutritional insults in utero (Khanna, 2007). Maternal nutrition is a major determinant of intra-uterine development of the fetus, birth weight of the infant as well as subsequent growth and development of the child (Reddy, 1993).

In a prospective cohort study of 8729 pregnant women in Denmark, low dietary fish intake was "strong" risk factor for preterm delivery and low birth weight (the incidence of preterm delivery was 7.1% for women who never ate fish compared with 1.9% for women who ate fish at least once per week) (Jensen, 2006; Olsen *et al,* 2002). Compared with offspring of mothers who had reported eaten not more than 13 meat/fish portions per week, the average cortisol concentration were raised by 22% and 46% in offspring of those reporting 14-16% and at least 17 portions per week, respectively. Diets with low carbohydrate or high protein have been associated with an increased risk of kidney problems and metabolic ketoacidosis, another potential prenatal stressor. The onset of ketoacidosis starts when carbohydrate intake is restricted and simultaneously body turns to alternative energy sources like fat, acids (beta-hydroxybutyrate, acetoacetone and acetone) known as ketones in the blood. When the level of beta-hydroxybutyrate (by-product of ketoacidosis) rises during gestation period, it can inhibit psychological behavioral and scholarly development in offspring's (Mead, 2007). Malnutrition during this crucial period is certainly not due to poverty and lack of family resources, but to lack of knowledge and not giving priority to young child feeding (Ghosh, 1995).

Prevalence of low birth weight in Asia is higher than any other continent and this is strongly associated with the relative under nutrition of mothers in the region. LBW is probably the main reason why over 50 % of the children in Asia are underweight. It also increases the risk of other health and developmental problems. Interventions to reduce the prevalence of LBW therefore need high priority (Mohanty *et al,* 2012c). Some recommendations to overcome the LBW syndrome are listed below:

- Undernourished women and those having low body weight (>40 kg) must take energy supplements to improve pregnancy outcomes.
- Micronutrient supplementation is extremely important during pregnancy as it can substantially reduce maternal anemia, mortality rate, birth defects, preterm delivery and also improve breast milk quality.
- Marine fishes are rich in omega 3 PUFAs, especially EPA and DHA. The estuarine/migratory fishes like *Tenualosa ilisha* are also a rich sources of ω-3 PUFAs. Oily fish

helps to prevent a range of health problems like childhood asthma and Attention Deficit Hyperactivity Disorder (ADHD) in pediatric population and pregnant women need to include marine fishes and other omega-3 PUFA rich fishes like hilsa, at least 2/3 servings per week, to meet the EPA +DHA requirement.

- Maternal seafood consumption is essential for optimum neural development of the child as seafood is a predominant source of omega-3 fatty acids (Hibbeln *et al,* 2007). Lower omega-3 fatty acid intakes in pregnancy predicts lower verbal IQ, increased risk of suboptimum outcomes for prosocial behavior, fine motor, communication, and social development scores. Therefore, pregnant women are advised to have seafood intakes of more than 340 g per week so as to ensure proper neuronal development of the child.

- Fish is a rich source of quality animal proteins. As, unlike other sources of animal proteins, fishes are available in large varieties and they also come in different price ranges, fish is affordable by a common man for meeting the protein requirement of the family. Therefore, fish consumption, in plenty, before and during pregnancy must be encouraged for all types of consumers.

Previous studies have shown that there is a direct relationship of health involvement with fish consumption (Altintzoglou *et al,* 2011). This effect can be assessed using anthropometry. The advantage of anthropometry is that body measurements are sensitive over a full spectrum of nutrition whereas biochemical and clinical indicators are useful only when a child is at least moderately malnourished (WHO, 2005). Common anthropometric indicators of child nutrition are combination of body measurements and age because the short term response of a child's body to inadequate food intake is to slow or stop growth which is reflected mainly through height and weight parameters. Previous studies have also shown that children of literate mothers have better anthropometric measurements than children of illiterate mothers (Sanghvi *et al,* 2001; Arya *et al,* 1991; Gupta *et al,* 1991). Moreover, according to a cross sectional survey carried out at Farakka and Cochin in the fishermen community (freshwater versus marine fish consuming population) showed that children in the age group of 1 year and 2–3 years are healthier in the marine fish eating population as compared to their freshwater fish eating counterparts considering body weight as a measure (Mohanty *et al,* 2012).

Clinico-Epidemiological Survey (CLEPS)

Survey

The word "survey" is used most often used to describe a method of gathering information from a sample of individuals. This "sample" is usually just a fraction of the population being studied. A survey may focus on factual information about individuals, or it may aim to collect the opinion of people to speak of the obstacles they are encountering and coping with. Participation in a survey allows them to debrief, yet interviewers may ask questions that respondents are reluctant to answer or even think about (Dyregrov, 2000). Since survey research is always based on a sample of the population, the success of the research is dependent on the representativeness of the population of concern. Firstly, we must define what we mean by a population. Population is an aggregate of individuals having some characters in common. Sample is a part of population where individuals are selected with some pre-assigned probability (Gupta *et al,* 1991). Survey methodology seeks to identify principles about the design, collection, processing, and analysis of surveys in connection to the cost and quality of survey estimates. It focuses on improving quality within cost constraints, or alternatively, reducing costs for a fixed level of quality. Survey methodology is both a scientific field and a profession. Part of the task of a survey methodologist is making a large set of decisions about thousands of individual features of a survey in order to improve it (Groves *et al,* 2009). A correctly designed survey is an excellent tool for collecting and evaluating data. Each of the following important steps should be considered while developing a survey (National Emergency Medical Service for Children Data Analysis Resource Center, NEDARC):

1. Goal of the survey should be established.
2. Interviewing methodology should be designed.
3. Questionnaire should be designed accordingly and pre-tested.
4. The gathered information should be converted into electronic format.
5. The data generated should represent meaningful information without any invalid values.
6. A final report should be prepared in accordance with the results of the survey.

Epidemiological survey

Epidemiological survey is a method of data collection from a target population samples to establish factors causing or contributing to a disease and to develop potential methods for prevention. It includes the study of health-events, health-characteristics or health-determinant

patterns in a population. It is the cornerstone method of public health research. Epidemiologists are involved in the design of studies, collection and statistical analysis of data, and interpretation and dissemination of results (Porta, 2008). Major areas of epidemiological study include outbreak investigation, disease surveillance and screening (medicine), biomonitoring, and comparisons of treatment effects such as in clinical trials. Epidemiologists rely on a number of other scientific disciplines such as biology (to better understand disease processes), biostatistics (to make efficient use of the data and draw appropriate conclusions), and exposure assessment and social science disciplines (to better understand proximate and distal risk factors, and their measurement).

It can also be defined as a medical survey conducted in an epidemic focus to discover the source of an infection, the means by which the causative agent was transmitted, and the circumstances that gave rise to the disease. The findings are used to devise ways of preventing the disease from spreading. Individuals stricken by the disease and those persons who have had contact with them are interviewed. The latter also undergo laboratory testing. The survey may also include tests on objects from the environment, entomological and in the case of zoo noses epizootic surveys, and inspection of water sources. In the case of intestinal infections, restaurants and other places where food is prepared are inspected. The characteristics of the disease and the number of sick persons determine the type of survey to be conducted.

The results of the survey are recorded on an epidemiological survey map. The findings determine the actions to be taken with respect to the individuals who have had contact with sick persons (medical observation, isolation, immunization, and chemoprophylaxis). They also determine disinfection measures and steps to improve the sanitary condition and maintenance of water-supply facilities and food-service facilities. The findings are also used to study the patterns of distribution of infectious diseases and to devise control measures.

Clinico-epidemiological survey (CLEPS)

The application of the logical and quantitative concepts and methods of epidemiology to problems (diagnostic, prognostic, therapeutic, and preventive) encountered in the clinical delivery of care to individuals is included in a clinico-epidemiological survey. The population aspect of epidemiology is present because these individual patients are members of conceptual populations.

Survey Ethics

Survey ethics is a very crucial part of any survey. Every survey should include some rules or standards governing the conduct of a person or the members. Professional's ethics of

survey practitioners should not be limited to conducting surveys but also extend to taking responsibilities for the impacts of survey results. For the successful completion of any survey, some set of rules should be followed so that the desired information can be obtained, some are as follows:

1. Questions without a clear analysis plan should be dropped, particularly when a survey has key questions and hypothesis.

2. Question should be precise and to the point, so that the respondent doesn't get irritated during the course of the interview time period.

3. Controversial questions should be tactfully handled so that the respondent's emotions are not hurt.

4. The interviewer should be polite and calm so that the right information can be extracted easily. The main ability of a good interviewer is to approach a stranger and persuade them to participate in a survey.

5. Survey ethics need to be reconsidered more from a respondents view point rather than conducting them in a practitioner's driven manner as is the norm.

Do's and Don'ts of Survey

It represents a list of some "Do's" and "Don'ts" which should be considered when crafting a questionnaire which includes some of the key components of a well-written questionnaire.

Do's

- If respondents misinterpret questions, or if two respondents interpret the same question in different ways, data becomes less valuable. Thus it is important to make your survey questions as clear and unambiguous as possible.

- A little introduction or welcome message will help respondents to better understand what and why they are being asked to respond. This may be especially true if there is some indication in the introduction as to how the information gathered will be synthesized and reported back to respondents, or perhaps how it will be used to make policy changes that could be beneficial to the respondent community.

- Some questionnaires are so lengthy that they cause annoyance and frustration on the part of the respondents. To avoid this problem the investigator should

carefully define the information required and write as few questions as possible to obtain that specific information. Questions that are peripheral, unimportant, and unnecessary to the study goal should not be included.

- Personal and confidential questions should be asked at the end of the questionnaire as early appearance of disconcerting questions may result in respondents discontinuing the questionnaire resulting in a lower overall response rate.

Don'ts

- Sensitive questions can increase psychological stress and compromise the accuracy of responses (Adey 1996). Talking about traumatic experiences can sometimes be positive, but often it is not.
- Participation in a survey also deprives respondents of economic opportunities, e.g. time for farming, trading or gathering water and firewood. Because of the risk of emotional and economic opportunities costs, individuals should be given the choice of whether to participate in survey (ORC Macro 2006).
- Participation in a survey is not always willing (Leaning, 2001). Some respondents believe that refusal to be interviewed could be interpreted as refusal of assistance.
- When the target area is an emergency " hot spot" that draws international attention, more agencies rush to conduct survey as a result limited access to the specific areas (e.g. due to security situations) allows a smaller sampling frame to be made available for a larger number of researchers. These conditions increase the probability that the same communities and households will be selected.
- Households in the same communities should not be repeatedly contacted and selected for similar surveys. A joint survey, one of the most feasible solutions to avoid duplicated efforts, not only relieves the respondent's psychic burden and an opportunity cost but also saves survey resources.
- Another advantage of conducting a joint survey is to allow agencies to agree on methods and interpretation of results. Even when two surveys are conducted in the same area to measure the same indicators during the same period, the results could be significantly different due to differences in survey methods.
- Survey practitioners should avoid creating unnecessary political debate that stems from survey results.
- Survey practitioners should give enough time to respondents to respond to the set of questionnaires and not make haste.

Clinico-epidemiological Survey under Outreach Activity on Nutrient Profiling and Evaluation of Fish as a Dietary Component (Outreach activity#3)

Questionnaire:

A questionnaire is a series of questions asked to individuals to obtain statistically useful information about a given topic (Merriam-Webster's). A good questionnaire should not be too lengthy, simple english should be used and the question shouldn't be difficult to answer. A good questionnaire requires sensible language, editing, assessment, and redrafting. When properly constructed and responsibly administered, questionnaires become a vital instrument by which statements can be made about specific groups or people or entire populations. The clinic-epidemiological survey under Outreach acitivity#3 was carried out using structured 'Questionnaire' designed for the purpose. The 'Questionnaire' was developed in consultation with the Nutrition Foundation of India, New Delhi. The questionnaire is broadly divided into three categories (Annexure-1):-

(i) Socio- Demographic characteristics:

This part of the proforma takes a brief about the social and economic condition of the respondent viz. socio-economic status, type of house, means of transport, means of entertainment, drinking

water source etc. Socio-economic status is recorded in a three point scale i.e. low (<Rs. 5000), middle (Rs 5000-10000), high (> Rs 10000) gives an impression about the earning of the respondent which is further a crucial factor in determining the health profile of the family.

(ii) Household proforma:

Detailed description about the respondent and his family members are recorded in this proforma and height and weight of the individuals are measured according to anthropometric standards.

(iii) Food and Nutrient profile:

This records the basic food habits of the respondent and its family members i.e. Vegetarian or Non-vegetarian which further includes details about the main courses. The most relevant section of this questionnaire includes fish consumption pattern of the participants which is further subdivided into following questions:

1. Frequency of major food intake a) 1 time b) 2 times 3) 3 times,
2. Type of fish consumed (Predominantly) a) Marine b) Freshwater c) Brackish water,
3. Name of preferred fish,
4. Frequency of fish consumption a) Daily, b) Weekly 3-4 times to c) Rarely monthly once.
5. Fish consumption (gm/week),
6. Fish commonly available,
7. Fish commonly consumed by the family.

Survey at Farakka (West Bengal), Cochin (Kerala) and Lakshwadeep

Quantitative descriptive data were collected through a cross-sectional population based survey at Farakka, West Bengal, Cochin, Kerala and Lakshwadeep (Fig 7). The selection of the places where according to their geographical location i.e. around freshwater and marine water bodies respectively and the considerable differences in the fish consumption pattern and habits between those places. The fieldworks for the study were performed by research scholars, volunteers and NGO respectively.

The questionnaire was extensively pre-tested by researchers in order to identify and eliminate potential problems. Fieldwork started after editing, correcting and pre-testing the questionnaire.

Participants were randomly selected from population according to their age, fish consumption pattern and their profession. The age groups that were considered ranges from 1-3 years, preadolescence age group (10-12 years female) and the maternal age group (20-30 years female) etc. From the marine population group, the birth weight of new born babies and their respective mother's age was recorded.

Detailed account of socio-economic status, fish consumption pattern and rate were recorded. Different age groups from the range were nearly equally represented. The sample further varies in terms of household size and type, profession of the head of household etc.

Participants were asked by volunteers all the questions in the questionnaire and the proforma was filled up by the volunteers accordingly. Survey questions which were relevant within the scope of the present study were (1) Frequency of fish consumption which was registered on a 3 points scale that ranged from a) Daily, b) Weekly 3-4 times to c) Rarely monthly once. (2) Fish consumption (gm/week), (3) Fish commonly available, (4) Type of fish consumed (Predominantly): a) Marine b) Freshwater c) Brackish water, (5) Fish commonly consumed by the family. As the age group considered in our study includes children of 1 year and 2-3 years therefore, their details were taken from their parents. Women of child bearing age (maternal age group), preadolescence girls and child height and weight measurements were obtained according to standard anthropometric procedures (WHO, anthropometry, 1995). The data generated after successful completion of the survey was fed in software named 'Fish Consumption and human health' and a complete database was created. Fishes which are commonly consumed by respondents in the freshwater population include hilsa (*Tenualosa ilisha*), pungus (*Pangasius pangasius*), bhola (*Pama pama*), kogoli (*Ailia coila*), khoira (*Gudusia chapra*) etc and in marine water population tuna (*Thunnus thynnus*), sailfish (*Istiphorus platypterus*), wahoo (*Acanthocybium solandri*), needlefish (*Tylosurus crocodiles*) etc are commonly consumed.

Fig 7: Clinico-epidemiological survey carried out at different locations in India included marine fish consuming population at Cochin (Kerala), Lakshadweep and freshwater fish consuming population at Farakka, West Bengal. The survey at each place consisted of more than 10,000 individuals.

Software : Fish Consumption and Human health

A huge amount of data is generated after successful completion of a survey which requires a systematic way of storage so that it can be processed to extract our desired information by giving a query. For this purpose specific software is developed i.e. Software #2: Fish Consumption and human health. This software is designed in the same format as that of the questionnaire containing three windows corresponding to socio-demographic, household proforma and food and nutrient profile respectively. It also includes a report wizard from which feeded data report can be generated (Annexure-1).

Questions to be answered from the software:

The data that is fed to the software can be extracted by giving a query in the form of questions given below:

Q1. Compare the birth weight of children between freshwater fisherman and non fisherman fish eating population?

Q2. Compare the birth weight of children between marine water fisherman and non fisherman fish eating population?

Q3. Compare the birth weight of children between freshwater fisherman and marine water fisherman population?

Q4. Compare the weight and height of children of age upto 1 year age between freshwater fisherman and non fisherman fish eating population?

Q5. Compare the weight and height of children of age upto 1 year age between marine water fisherman and non fisherman fish eating population?

Q6. Compare the weight and height of children of age upto 1 year age between freshwater fisherman and marine water fisherman population?

Q7. Compare the weight and height of children of age upto 2-3 years age between freshwater fisherman and non fisherman fish eating population?

Q8. Compare the weight and height of children of age upto 2-3 years age between marine water fisherman and non fisherman fish eating population?

Q9. Compare the weight and height of children of age upto 2-3 years age between freshwater fisherman and marine water fisherman population?

Q10. Compare the weight of preadolescent girls (11-13 years)/boys (10-12) between freshwater non fisherman population and freshwater fisherman population?

Q11. Compare the weight of preadolescent girls (11-13 years)/ boys (10-12) between marine water non fisherman population and marine water fisherman population?

Q12. Compare the weight of preadolescent girls (11-13 years)/boys (10-12) between freshwater fisherman and marine water fisherman population?

Q13. What is the weight and height of children born to mothers within the childbearing age (20-30 years)?

Q14. What is the weight and height of children born to mothers before the childbearing age (13-19 years)?

Q15. Compare the weight and height of children born to mothers within the childbearing age with the children born to mothers before the childbearing age

Q16. Compare the weight and height of males and females belonging to the geriatric population (60-75 years) between freshwater fisherman and non fisherman fish eating population?

Q17. Compare the weight and height of males and females belonging to the geriatric population (60-75 years) between marine water fisherman and non fisherman fish eating population?

Q18. Compare the weight and height of males and females belonging to the geriatric population (60-75 years) between freshwater fisherman and marine water fisherman population?

Q19. Compare the birth weight of children born to literate mothers than to illiterate mothers?

Q20. Compare the birth weight of children according to the socio economic status of their parents?

Q21. Compare the bodyweight of pregnant women between freshwater fisherman and marine water fisherman population?

Q22. What is the most prevalent disease in the freshwater fisherman population?

Q23. What is the most prevalent disease in the marine water fisherman population?

Fig 8: Demonstration workshop on software package for Nutrient Profile Data Compilation & Clinico-epidemiological Survey.

Case study:

1. Low Birth Weight (LBW) incidences in marine population:

Despite one of the lowest infant and child mortality rates in the developing world, an estimated 17-18% of babies in Kerala are born underweight (<2500g) (Sanghvi *et al,* 2001). However, in our survey carried out at Cochin, Kerala we found that 11.63% of new born babies are underweight or low birth weight babies. Moreover, a significant gender difference in mean birth weights, with female infants tending to weigh less than male infants (Mohanty *et al,* 2012) was also observed which is relevant with previous studies (Hirve *et al,* 1994) (Fig 9).

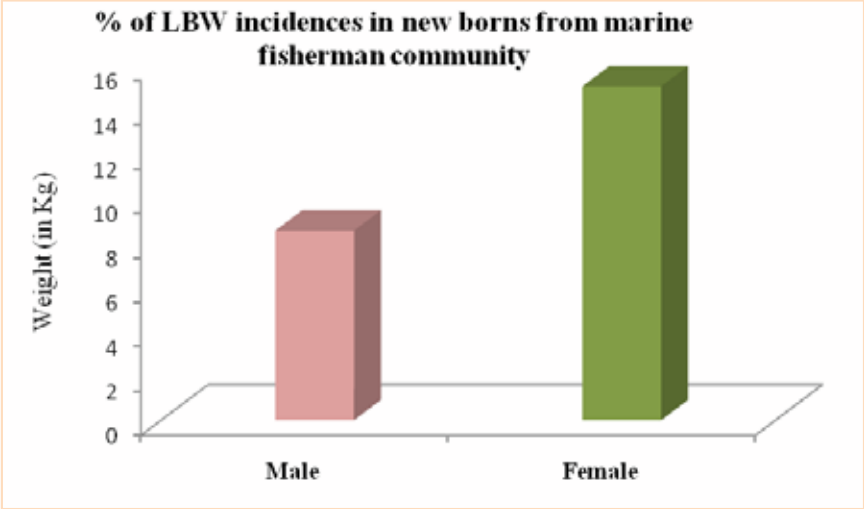


Fig 9: Low birth weight incidences in marine fisherman community. (Mohanty *et al,* 2012)

Correlating fish consumption with body weight:

(a) Fish consuming population (professional fishermen) and non-fishermen population (Control group):

Fig 10: Interaction session with local fisher man at the site of clinico - epidemiological survey at Farakka

A significant difference($p<0.05$) between the average body weight of children of age 1 year, 2-3 years, preadolescence girls and maternal age group among professional fishermen of both the population i.e. freshwater and marine water and their respective control i.e. the non-fishermen population were observed. The professional fishermen consume fish almost daily as they get it easily by catch and their family also enjoys fish delicacies and get the associated health benefits which is reflected in this study as a gain in body weight, therefore, it may be said that the fish nutrients has some contribution in body building and muscle mass growth. The nutritional benefits of fish are mainly due to the content of high quality proteins (fish provide 17% of the total animal protein and 6% of all proteins consumed by humans), vitamins and other essential nutrients (Olsen *et al*, 1986).

On the other hand, the control group i.e. the non-fishermen population who consume fish hardly 2-3 times a week but not daily like the professional fishermen as they have to purchase it and consume therefore does not get the associated health benefits of eating fish regularly. This is true in the sense that there socio-economic status does not permit them to buy fish regularly for their family. Therefore, when we compared the average body weight between these two groups, the professional fishermen have an added advantage which is reflected through a gain in body weight than their control group of their children at the age of 1 year and 2-3 years. The preadolescence girls and the maternal age group also showed similar results (Fig 11 & 12).

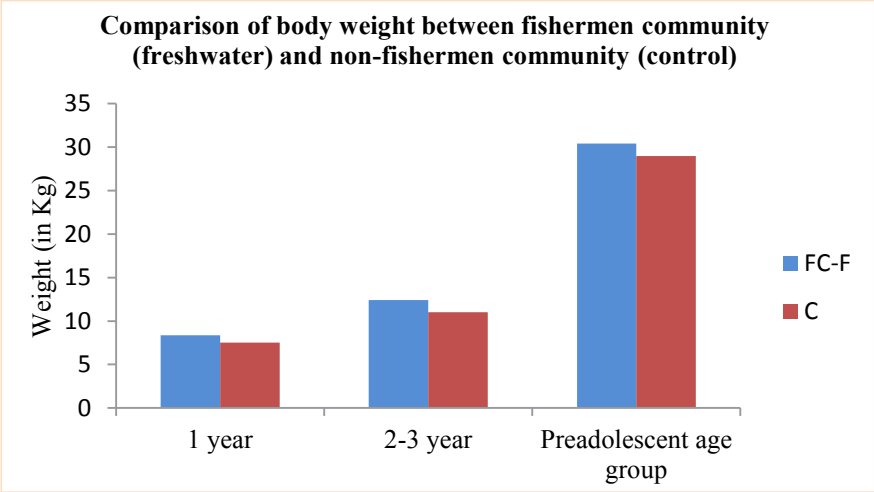


Fig 11: Comparison of body weight (in kg) between professional fisherman (freshwater fish consuming population) and control (non fisherman population) considering children of age 1 year. 2-3 year children, preadolescence age group. (Mohanty *et al,* 2014)

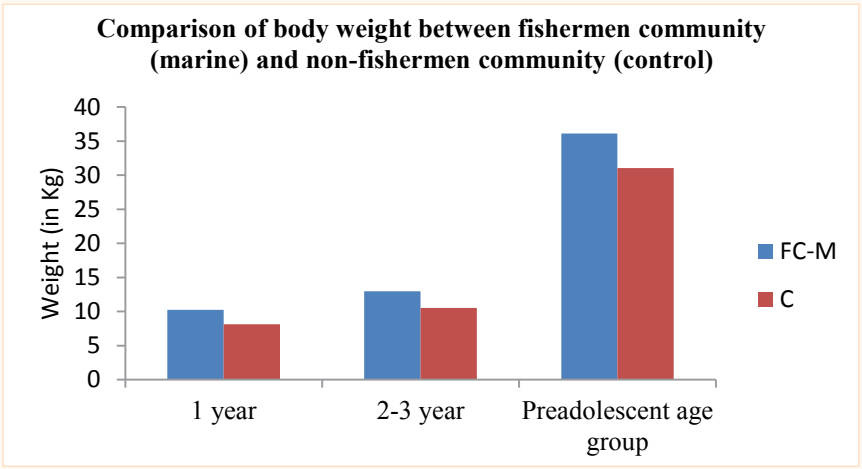


Fig 12: Comparison of body weight (in kg) between professional fisherman (marine fish consuming population) and control (non fisherman population) considering children of age 1 year, 2-3 year children, preadolescence age group (Mohanty *et al,* 2014)

b. Freshwater fish consuming population and marine fish consuming population

Fig 13: Mass awareness program (Subhas Pally, Farakka, West Bengal) during the clinico - epidemiological study.

The children in the age group of 1 year and 2-3 years, preadolescence age group and maternal age group are healthier in the marine fish eating population as compared to their freshwater fish eating counterparts considering body weight as a measurement (Fig 14) which is relevant to the fact that both these population include professional fishermen who get the advantage and associated health benefits of eating fresh fish. But the gain in body weight was more in case of marine fish consuming population (MP) than freshwater fish consuming population (FP) which is according to previous studies as marine food is rich in polyunsaturated fatty acids which play a potential role in increasing body weight. Eating seafood, which is rich in long chain n-3 fatty acids, may increase birth weight in two ways: it may prolong the duration of pregnancy by interfering with the prostaglandins involved in the process of parturition or it may increase the fetal growth rate by raising the ratio of biologically active prostacylins to thromboxanes and reducing blood viscosity, thereby facilitating placental blood flow (Olsen *et al,* 1993).

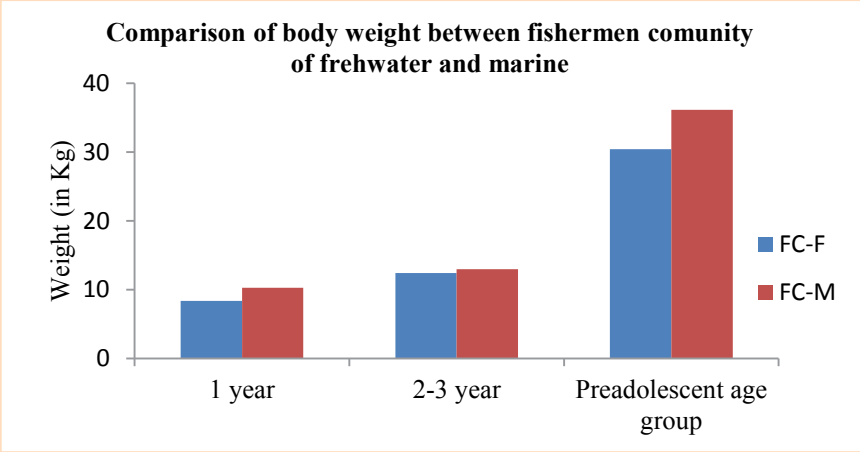


Fig 14: Comparison of body weight (in kg) between the professional fisherman of marine fish consuming population and freshwater fish consuming population (FP) considering children of age 1 year, 2-3 year children, preadolescence age group (Mohanty *et al,* 2014)

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Outreach Activity #3

Consortium Project

Fish Consumption & Human Health

Fisheries Division

KAB-II, ICAR,PUSA
New Delhi 110012

Lead Institute

CIFRI, Barrackpore

User Name

Password

CIFRI Barrackpore | CIFT Cochin | CMFRI Cochin | CIBA Chennai | CIFA Bhubaneswar | CIFE Mumbai | DCFR Bhimtal

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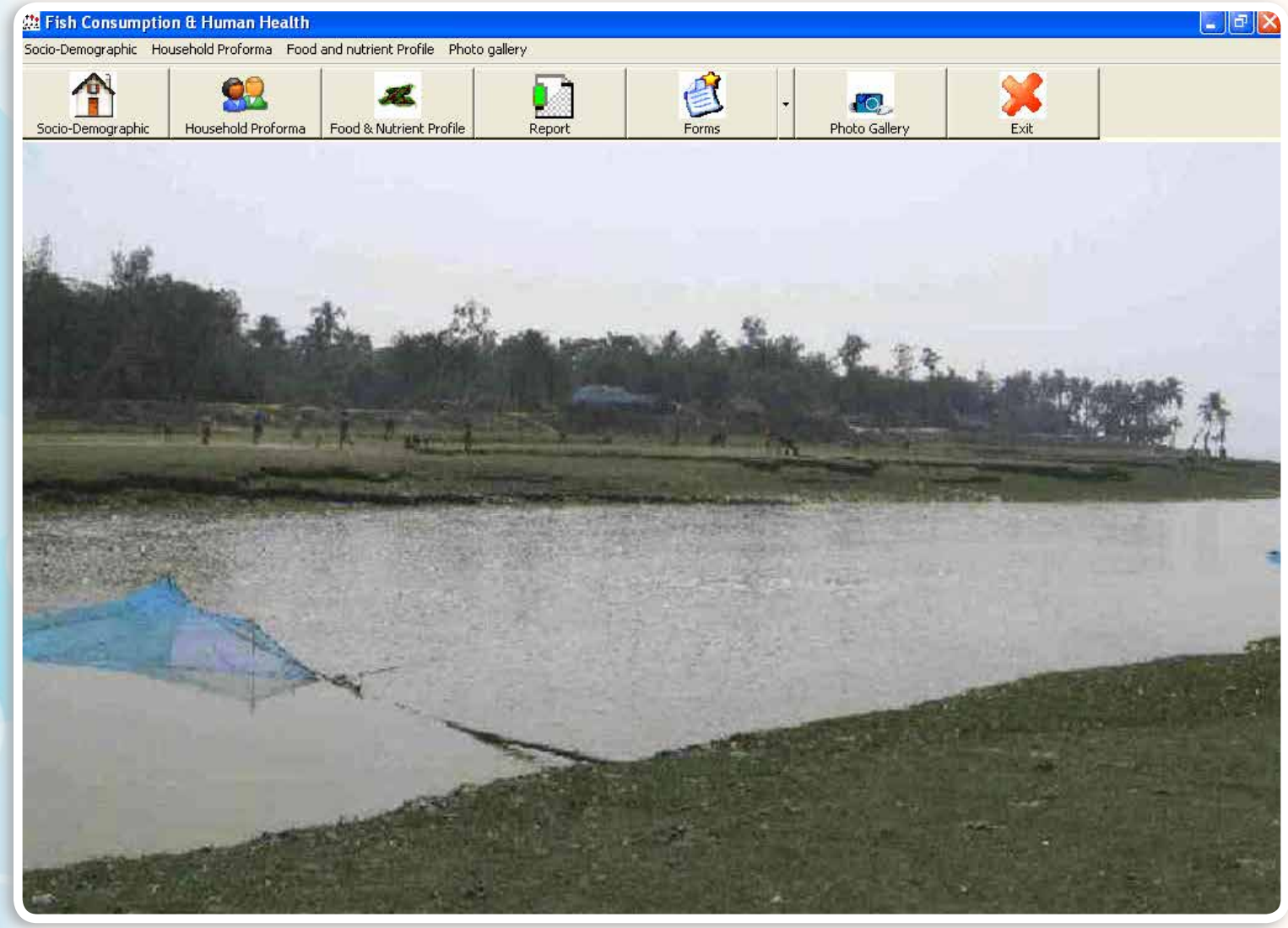
Fish Consumption & Human Health
Socio-Demographic
Household Proforma
Food and nutrient Profile
Photo gallery
Socio-Demographic
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Food & Nutrient Profile
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Fish Consumption & Human Health
Socio-Demographic
Household Proforma
Food and nutrient Profile
Photo gallery
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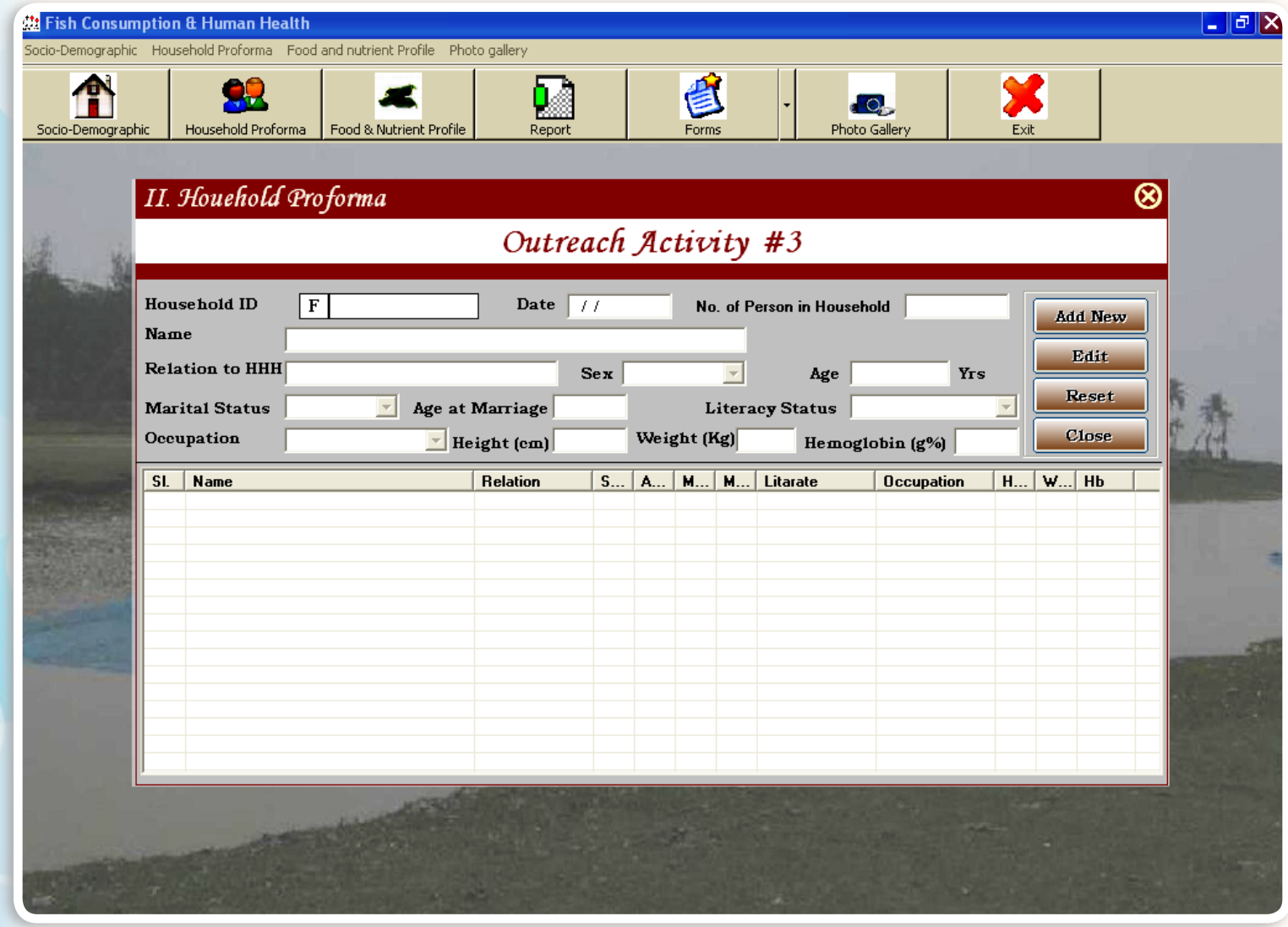
Household Proforma
Food & Nutrient Profile
Report
Forms
Photo Gallery
Exit
Socio - Demographic Characteristics
Outreach Activity #3
Household ID
F
Date
State
District
Block
Village
Police Station
Household Type
Household Size
Caste
Religion
Socio-economic status
Work status of HHH
Dietary Habits
Rural :
Type of house
Ownership of House
No. of rooms in the house
Toilet facility in household
Means of transport
Coocking fule used at home
Drinking water source
Means of Entertenment
Kitchenware (Predominantly
Number of family members in following age groups
Pregnant Woman
Lactating Woman
Add
Edit
Search
Form 2
Delete
Reset
Close
Form 3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Household Proforma
Food and nutrient Profile
Photo gallery
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Food & Nutrient Profile
Report
Forms
Photo Gallery
Exit
II. Household Proforma
Outreach Activity #3
Household ID
F
Date
/ /
No. of Person in Household
Name
Relation to HHH
Sex
Age
Yrs
Marital Status
Age at Marriage
Literacy Status
Occupation
Height (cm)
Weight (Kg)
Hemoglobin (g%)
Add New
Edit
Reset
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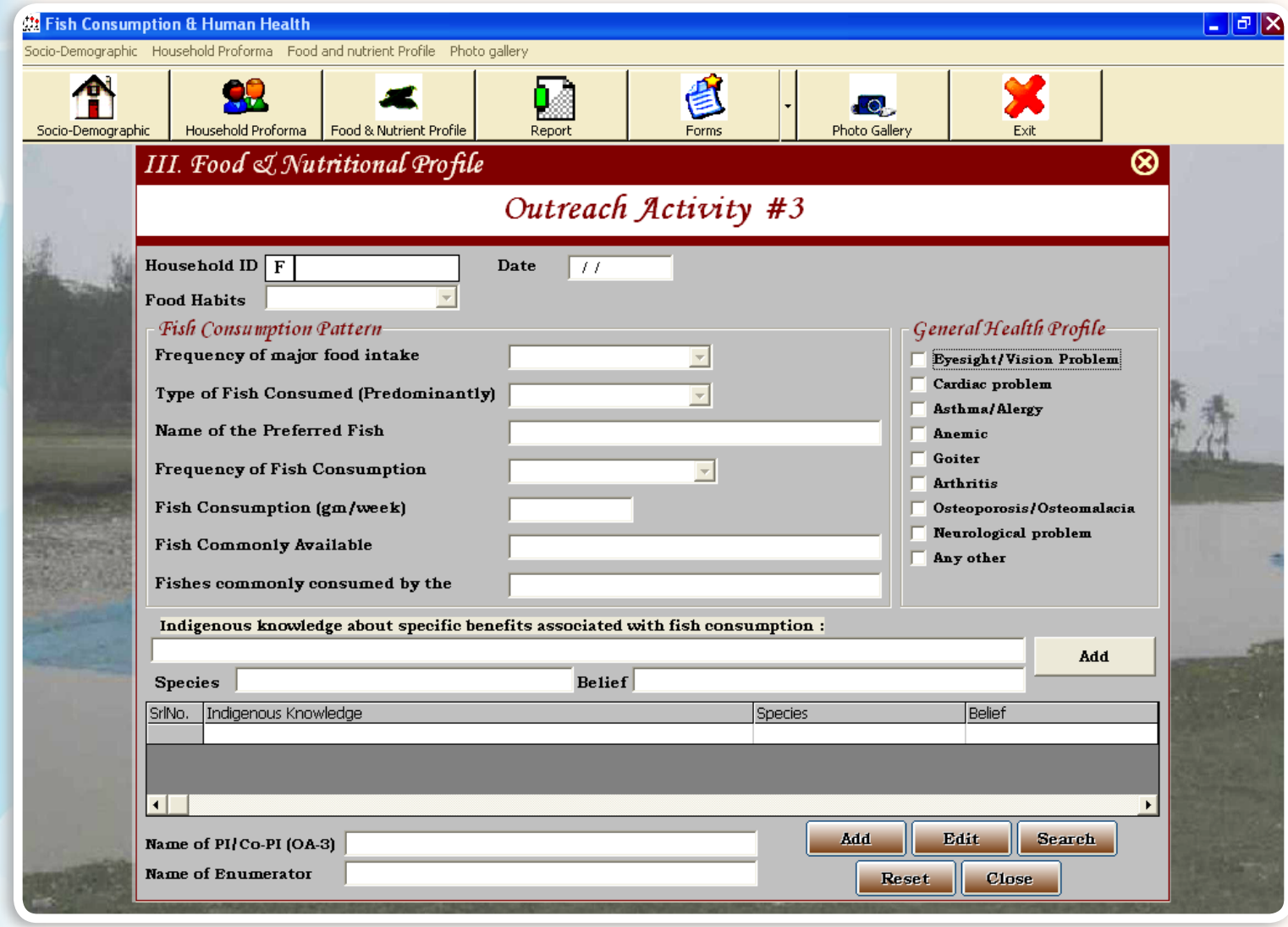
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Food and nutrient Profile
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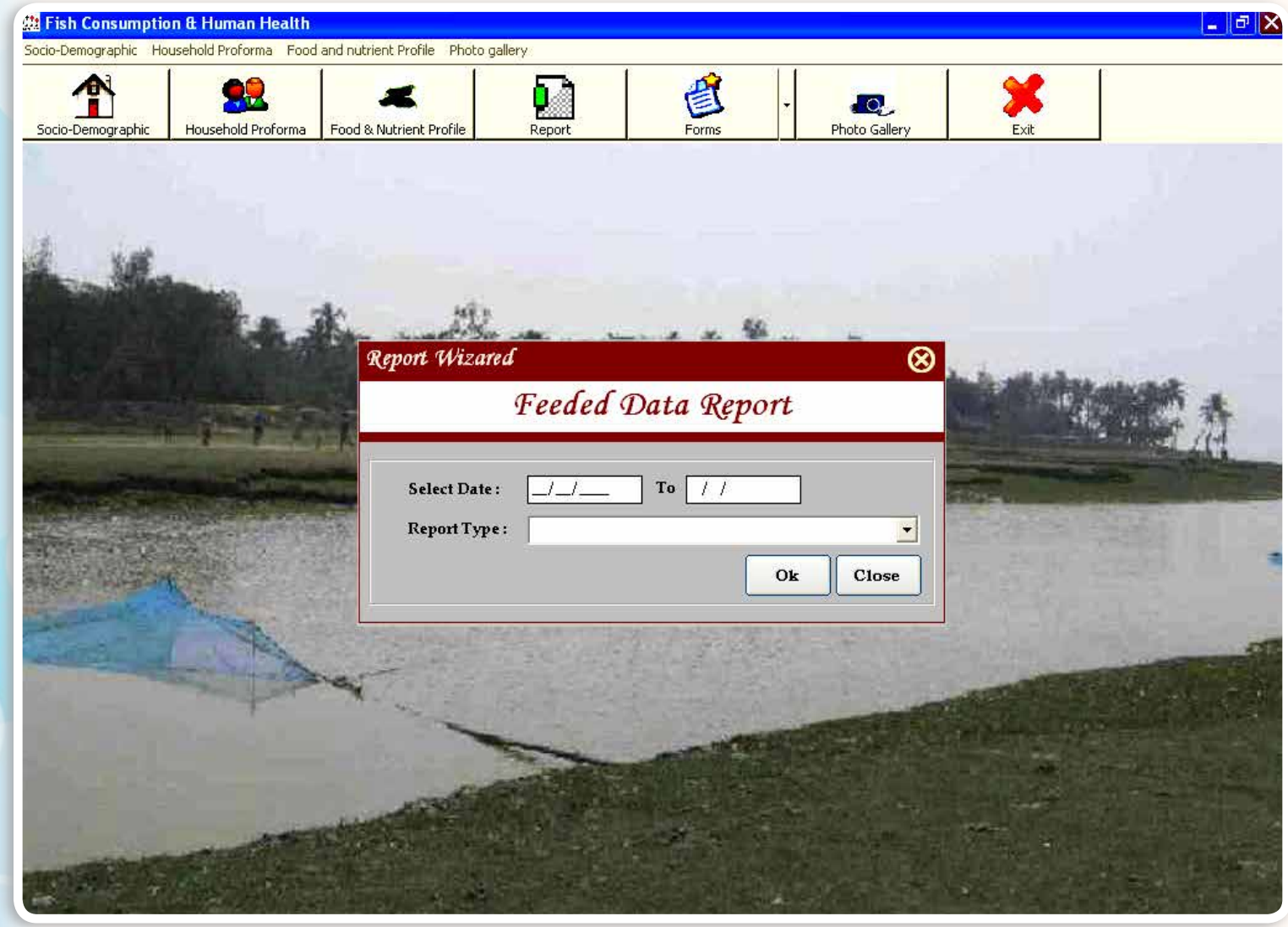
Household Proforma
Food & Nutrient Profile
Report
Forms
Photo Gallery
Exit
III. Food & Nutritional Profile
Outreach Activity #3
Household ID
F
Date
/ /
Food Habits
Fish Consumption Pattern
Frequency of major food intake
Type of Fish Consumed (Predominantly)
Name of the Preferred Fish
Frequency of Fish Consumption
Fish Consumption (gm/week)
Fish Commonly Available
Fishes commonly consumed by the
General Health Profile
Eyesight/Vision Problem
Cardiac problem
Asthma/Alergy
Anemic
Goiter
Arthritis
Osteoporosis/Osteomalacia
Neurological problem
Any other
Indigenous knowledge about specific benefits associated with fish consumption :
Add
Species
Belief
SrlNo.
Indigenous Knowledge
Species
Belief
Name of PI/Co-PI (OA-3)
Name of Enumerator
Add
Edit
Search
Reset
Close


Fish Consumption & Human Health
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Food and nutrient Profile
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Feeded Data Report
Select Date :
To
Report Type :
Ok
Close

FISHERIES DIVISION, KAB-II, ICAR, PUSA, NEW DELHI 110012

INSTITUTE: CENTRAL INLAND FISHERIES RESEARCH INSTITUTE, BARRACKPORE

OUTREACH ACTIVITY-3 (Consortium Project):

Nutrient Profiling and Evaluation of Fish as a Dietary Component

Objectives: Survey on Fish Consumption Rate and Pattern and Correlating General Health Profile of Population with Fish Consumption, With Special Emphasis on Low Birth Weight (LBW)

State: **District:** **Block:**

Village: **Police Station:**

DATE: _____

SL NO. _____

I. SOCIO–DEMOGRAPHIC CHARACTERISTICS

Q. No.	Q.No.	Code/No
1. State		
2. District		
3. Anganwadi Center Code (if any)		
4. Household Number		
5. Household Type 1. Joint 2. Nuclear		
6. Household size		

7. Caste 1.SC 2.ST 3.OBC 4. Others		
8. Religion 1. Hindu 2. Muslim 3. Christian 4. Sikh 5. Any other, specify		
9. Socio-economic status 1. High 2.Middle 3.Low		
10. Literacy status of head of household (HHH) 1. Illiterate 2.Can read or write 3. Schooling – primary 4. Schooling-secondary or more		
11. Literacy status of the wife of the HHH 1.Illiterate 2. can read or write 3.Schooling-primary 4.Schooling-secondary or more		
12. Work status of HHH **Urban** 1.Not working 2.Unskilled 3.Semi –skilled 4.Clerk/Teacher /Office worker 5.Business 6 .Any Other **Rural** 1.Not working 2.Landless labourers 3.Cultivators 4. Landowners 5.Artisans 6.Service		
13. Work status of wife of HHH **Urban** 1.Not working 2.Unskilled 3.Semi-skilled 4. Clerk/Teacher/Office worker 5.Business 6.Any other **Rural** 1.Not working 2.Landless labourers 3.Artisans 4.Service 5. Domestic Help 6. Any other		
14. Dietary habits 1.Vegetarian2.Non-Vegetarian		
15. Monthly Family Income 1.<Rs50002.<Rs5000-10,000 3.>Rs10,000		
16. Which locality do you live in?**Urban:**1.Slum/J J Colony 2.Resettlement Colony 3. Regular colony **Rural:** 1.Centre of village 2.Periphery 3.Harijan Basti		
17. Type of house 1.Kuttcha 2.Semi Pucca 3. Pucca		
18. Ownership of House 1.Own 2.Rented		
19. No. of rooms in the house 1. One 2.Two 3.Three 4.>Three		
20. Toilet facility in household 1. No facility 1. Sulabh 2.Shared pit 3.Own pit 4. Own flush		
21. Means of transport 1. Public transport 2. Bicycle 3.Scooter/Moped 4.Any other		
22. Cooking fuel used at home 1. Kerosene/Charcoal/Wood 2.Gas/Elctricity 3.Other		
23. Drinking water source 1.Public Tap 2.Hand pump/Submersible/Overhead Tank at home		
24. Means of Entertainment 1. Radio 2.T.V. (B/W) 3. T.V.(Colour)		
25. Kitchenware (Predominantly) 1. Clay 2.Aluminium 3.Cast Iron 4.Brass/Copper		

5.Stainless steel		
26. Number of family members in following age groups		
26.1 0-<3 years		
26.2 3-6 years		
26.3 Adolescent Girls (10-19 years)		
26.4 Pregnant Woman		
26.5 Lactating Woman		

II. HOUSEHOLD PROFORMA

27. Number of Persons in the Household

S.No.	Name	Relation to head of household	Sex	Age (years)	Marital Status M/N	Age at Marriage (years)	Education*	Occupation*	Height (in cm)	Weight (in Kg)	Hemoglobin (Hb)
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											

*** Refer Q- 9, 10, 12**

III. FOOD AND NUTRITIONAL PROFILE

28. Food habits: Vegetarian/Non-vegetarian
    (A) Vegetarian-normal food – a) Rice, b) Chapatti, c) Pulses, d) Fruits/vegetables, e) Milk
    (B) Non-vegetarian – a) Meat, b) Fish, c) Chicken, d) Egg, e) Milk, f) Others

29. Fish Consumption Pattern
    a) Frequency of major food intake- 3 times/ 2 times/ 1 time
    b) Type of fish consumed- Marine / Freshwater / Brackish water
    c) Preferred fish-
    d) Frequency of fish consumption-
    e) Fish consumption (gm/ week)-
    f) Fishes commonly available-
    g) G) Fishes commonly consumed by the family-

30. General Health profile
    (a) Eyesight/Vision problem b) Cardiac problem 3) Asthma/Allergy d) Anemic problems e) Goiter
    h) Osteoporosis/Osteomalacia g) Neurological problems h) Any other

31. Indigenous knowledge about specific benefits associated with fish consumption: **Species** **Belief**

Name of PI/ Co-PI (OA-3)	**Signature & Name of Enumerator**	**Date:**

Bpm/151108

Publications from Outreach Activity #3:

Nutrient Profiling and Evaluation of Fish as a Dietary Components

Contribution No.	Publication details
1.	Nutrient Profiling of Fish. T. V. Sankar, S. Mathew, R. Anandan, K.K Asha and B. P. Mohanty. CIFT, Cochin. P.61. 2010. ISBN 978-81-905878-3-9
2.	Fish as Health-Food (Folder in English, Hindi, Bengali), CIFRI, Barrackpore, 2010
3.	Nutritional Significance of Small Indigenous Fishes in Human Health. B. P. Mohanty, B. K. Behera and A. P. Sharma. Bulletin No. 162, CIFRI, Barrackpore. P.73.2010 ISSN 0970-616X
4.	Therapeutic Value of Fish. B. P. Mohanty, D. Sudheesan, T. V. Sankar, M.K. Das, A.P. Sharma. Bulletin No. 170, CIFRI, Barrackpore. 2011. ISSN 0970-616X
5.	Tenualosa ilisha: A Rich Source of ω-3 PUFAs. B.P. Mohanty, Soma Das, U. Bhaumik and A. P. Sharma. Bulletin No. 171. CIFRI, Barrackpore. 2011. ISSN 0970-616X
6.	Manab Swasthya Me Chhoti Deshi Machhliyon Ke Poshn Guno Ka Mahatwa. B. P. Mohanty, B. K. Behera, A. P. Sharma. Bulletin No.172, CIFRI, Barrackpore. 2011. ISSN 0970-616X
7.	Nutrient profile and health benefits of coldwater fishes. D. Sarma, M. S. Akhtar, N. N. Pandey, N. Sahi, B.P. Mohanty, P. C. Mahanta. Bulletin No.18, DCFR, Bhimtal. 2011
8.	Marine Fishes in India: Their Importance in Health and Nutrition. Kajal Chakraborty, P. Vijaygopal, K. K. Vijayan, B. P. Mohanty. CMFRI, Cochin special publication no. 110, 2012 ISSN 0972 2351
9.	Machliyon ke aushodhiya gun. B. P. Mohanty, D. Sudheesan, T. V. Sankar, M.K. Das, A.P. Sharma. Bulletin no. 176. CIFRI, Barrackpore. 2013.