EFFECT OF INTRODUCTION OF ELIMINATION DIET AND SUPPLEMENTATION OF FLAX SEED IN AUTISTIC CHILDREN (2-7 YEARS)

By

APARNA.S

(Reg. No. 07PN01)

A THESIS SUBMITTED TO THE
AVINASHILINGAM UNIVERSITY FOR WOMEN
COIMBATORE – 641 043

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREEOF

MASTER OF SCIENCE
IN
FOOD SCIENCE AND NUTRITION

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CERTIFIED AS BONAFIDE RESEARCH WORK

Signature of the	**Signature of**
Head of the Department	**the Guide**

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"Dedicated to the Lord Almighty, honorable Vice chancellor

madam, respectable guide, lovable parents and brother"

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I. INTRODUCTION

Autism is neither a puzzle nor a disease
Autism is a challenge, but certainly not a devastating one.
-Trisha Van Berkel

In every country there are some children and adults who are mentally retarded. India is a vast country with one billion people. From the findings of a few random sample surveys in different cities like Mumbai, Kolkata, New Delhi and Mysore, the retarded population in India would be anywhere between 15 and 22 million. Recently mental deficiency was a topic which aroused little interest in the general public or among physicians and psychologists.

Of all the conditions that involve mental retardation, one that deserves special attention, by virtue on both its fame and its severity is autism. It has long been recognized that some children are profoundly disturbed, sometimes from earliest infancy. Autism, more recently referred to as autism spectrum disorders is classified under the umbrella of pervasive development disorders which include Asperger syndrome, Retts and childhood disintegrative disorder. (Hamilton, 2000).

Autism was first described by Kanner (1943) a child psychiatrist. Hence autism is also called Kanner syndrome or infantile autism. It is characterized by deficits in social interaction, communication and intelligence. People who suffer from autism usually exhibit behaviour that are repeated over and over again in very standard pattern (http://www.faqs.org/health/silk-v1/autism.html).

Children with autism are found in all cultures and all social and economic groups. Estimated prevalence rates range from a low of 21 to 31 cases per 10,000 children to a high of one case of autism out of every 500 children (Organisation for Autism Research, 2003 and Centre for Disease Control and Prevention, 1997). Every year, the National Institute of Mental Health, Secunderabad, registers approximately 100 – 125 new cases, much higher compared to five years ago (Business Daily, The Hindu, 2007).

Socio-economic status and cultural background are not the major risk factors for autism. Gender is a significant risk factor, however males with autism generally outnumber females by 3 or 4 to 1 margin. Specifically females with autism generally have more severe symptoms of autism than males with autism. Another risk factor for autism is the presence of the disorder in siblings. The presence of autism in siblings of children with autism is estimated at 2 to 5 percentage (Gillberg and Coleman, 2000), a rare that is substantially higher than that of the general population. It is believed that atleast some cases of autism involves an inherited or acquired genetic defect (Thomas, 2004). Researchers have proposed that the immune-system, metabolic and environmental factors may play an important part as well.

The three major characteristics of autism are expressed as – impairment in social interaction, impairment in communication and restricted behaviour, interests and activities.

Some people with autism may be at nutritional risk due to their behaviour around foods and eating. Food refusal and difficulty in introducing new foods into the diet of a person with autism are common problems (http://www.ncpad.org/nutrition/falt.sheet). Many of the children have an extremely limited food repertoire, which is likely related to sensory regulatory difficulties, desires for sameness, etc.

Autistic children are said to have immature or problematic digestive system and are unable to breakdown complex proteins like gluten and casein. This sort of gut distress can cause arrays of symptoms and the child may have one or several symptoms.

These symptoms are clearly associated with a gut problem and the child may be experiencing additional symptoms that he or she is unable to communicate as listed below:

Clearly noticeable symptoms	**Unable to communicate symptoms**
1. Constipation	1. Abdominal pain
2. Diarrhoea	2. Heart burn
3. Vomiting	3. Bloated belly

4. Sensory irritability
5. Hard colic

It is important to safeguard the health of autistic children. Researchers believe that intervention must begin very early in the autistic children if they are to reach their full potential (Filipek et al., 1999). Despite this importance, the average age of diagnosis in the United States is 3 to 4 years and in many countries, it is much later.

No one therapy or method will work for all individuals with autism. Many professionals and families use a large range of treatment simultaneously, including behaviour modification, structured educational approaches, medication and counseling . Popular nutrition intervention include, mineral and vitamin therapy and elimination diet such as gluten free – casein free diet ; allergy diet ; essential fatty acid; mega vitamins ; specific carbohydrate diet and the body ecology diet (Mahan and Stump, 2008).

Dietary changes in these children have said to shown mild to dramatic improvement in speech and behaviour after the substances that cause allergy (gluten, casein, gliadin) are removed from their diet.

A gluten – free diet is an eating plan in which gluten is eliminated from the diet. Foods and drinks containing wheat, barley, rye, oats or recipes made from these grains are avoided. This diet is used in combination with casein free diet which calls for the elimination of milk protein (casein) and foods containing milk such as cheese, butter, yoghurt, ice cream, whey and some brands of margarine. Casein may be added to non milk products such as soy cheese and hot dogs in the form of caseinate (http://autismhealingsthresholds. com/therapy/gluten-free-diet).

Gluten and casein have an opiate – like effects. During the digestion of gluten and casein a number of peptides are produced which have strong similarities to opiate drugs (morphine and heroin). It is thought that some people cannot digest gluten and casein properly in which case these opiate like peptide would build up in the gut. If they are absorbed these peptides could act in a way similar to opiate drugs causing various powerful effects in the brain and nervous system. The theory that incomplete

digestion of wheat and diary food could cause disease was first proposed in 1966 by Doham in relation to schizophrenia.

More recently research, which has mainly focused on the role of gluten and casein derived peptides in autism has identified casomorphins (casein), gluten exorphines and gliadorphin (gluten) as likely to be the most problematic.

There is increasing evidence that fatty acid deficiencies or imbalances may contribute to childhood neuro developmental disorder. Omega – 3 – fatty acids are found to have a positive effect in the treatment of children with autism (Biol. Psychiatry, 2007). Flax seed is the best source of the omega – 3 – fatty acids and has 45 to 60 per cent of omega – 3 – fatty acid – alpha linolenic acid. It also contains a high quality protein, soluble fiber, vitamins, minerals and phyto-nutrient (lignin). Among various varieties of flax seed, the brown coloured seeds are rich in such fatty acids (Natural Health Journal, 2008).

Research indicates that there are potential benefits, that omega – 3 –fatty acids may have a role in addressing behavioural concerns and injurious behaviour in individuals with autism. Studies have also found that children with autism have lower level of omega – 3 – fatty acids than do typical children. Studies have established that the use of essential fatty acids in children with autism significantly increases language and learning skills (http://www.brighttots.com/Autism-Diet/omega 3 fatty acid diet).

Though therapies like behaviour therapy and occupational therapy do exist, there is a need to explore the impact of dietary intervention among autistic children. Intervention studies such as the effect of casein free and gluten free diet and the use of omega – 3 – fatty acids are scanty in India. Such studies suiting to Indian food habits would be of great boon to the parents of autistic children. Moreover these parents need to get educated adequately so that they would put on their own efforts to modify the diet of their children. With this in view, the present study entitled **"Effect of introduction of elimination diet and supplementation of flax seed in autistic children (2-7 years)"** was undertaken with the following objectives : To

- study the eating habits of the children.
- educate the parents on the importance of dietary modification for autistic children.

- study the impact of supplementing flax seed powder in the diets of autistic children and
- Introduce elimination diet and observe the changes.

II. REVIEW OF LITERATURE

The literature pertaining to the study on **"Effect of introduction of elimination diet and supplementation of flax seed in autistic children (2-7 years)"**, is reviewed under the following headings:

A. Definition, causes and characteristics of autism
B. Problems faced by autistic children
C. Treatment for autism disorders
D. Nutritional therapy for autism

A. DEFINITION, CAUSES AND CHARACTERISTICS OF AUTISM

Autism is a pervasive development disorder that is usually apparent from early childhood (Howlin, 1998). Autism was first described by Leo Kanner, a child psychiatrist in 1943. Kanner thought of autism as a childhood psychosis and believed that most autistic children were basically very intelligent (Bhatt, 2007).

Kay and Tasman (2006) defined autism as a psychiatric disorder of childhood characterized by marked deficits in communication and social interaction, preoccupation with fantasy, language impairment and abnormal behaviour such as repetitive acts and excessive attachment to certain objects. It is usually associated with intellectual impairment (http : //www.thefreedictionary.com/autistic).

Barlow (2000) considers autism as a type of pervasive developmental disorder of which there are three other disorders like Aspergr's disorder, Rett's disorder, childhood integrative disorder. People with pervasive development disorder experience problems with language, socialization and cognition.

Autism is a very complicated disorder that affects children typically from the age of three. The disorder is neurological in nature and primarily affects the areas of the brain where communication and social interaction is developed (http: //www.treatmentforautism.net/). World reference frames autism as an abnormal absorption with the self, marked by communication disorder and short attention span and inability to treat others as people(http: //www.worldreference.com/definition/autism).

Autism is a complex neuro behavioural disorder linked to early abnormalities of brain development. According to the National Institute of Neurological Disorder and stroke it affects upto six of every 1000 children (UT Houston Researcher study diet in Autistic Children, 2008). According to autism Europe, autism is considered to be a pervasive developmental disorder of the brain functions which prevents a person from organizing and understanding information transmitted by their senses. It causes a person to withdraw into own self and can affect the social relationship (http: //www.autismeurope.org/portal/Default.aspx?).

Harrison (2005) describes autism as a rare and severe psychiatric disorder of childhood with an onset before the age of two years. It is marked by an inability to communicate by speech or to form abstract concepts; repetitive and limited patterns of behaviour and obsessive resistance to tiny changes in familiar surroundings. Autistic children are unable to form normal personal relationships but they can become emotionally attached to objects.

Autism is a spectrum disorder varying in symptoms, severity and impact from person to person and ranging from those with no speech and limited cognitive ability to those of high IQ and typically highly focused interests and abilities. Repetitive behaviour are common across the spectrum, which include asperger syndrome (http: //www.articlebar.com/medicinearticle/ a definition of autism-spectrum-disorder-455798.html).

Autism is a heterogenous disorder which means that there are several known causes of autism. Many researchers suspect that autism results from genetically mediated vulnerabilities to environmental triggers. Researchers have found a link between autism, abnormal blood vessel function and oxidative stress (http: //www.themedguru.com/auticle). The Autism Society of America (2008) has linked autism to the difference in the structure in the brain. Magnetic Resonance Imaging (MRI) and Positron Emission Topography (PET) scans have shown abnormalities in the structure of the brain in autistic individuals. There are differences in the cerebellum, including the size and number of purkinje cells (http: //www.suite 101.com, http : // www.the national trust. in).

According to Rudy (2009), two theories link autism and vaccine may cause intestinal problems leading to the development of autism. The second theory suggests that mercury based preservative called thimerosal, used in some vaccine, could be connected to autism.

Rubin (2008) speculated that the precipitation itself, which might carry pollutants or its possible consequences such as increased TV-watching, decreased vitamin D levels or increased exposure to household chemical, might trigger autism in genetically susceptible children.

Schaffer et al. (2002) identified that genetic factors are important and it is probable that autism is related not to one gene but to several genes that each act independently, but in combination increases vulnerability.

There are several known causes of autism which may include phenyl ketonuria, tuberculosis and 15q duplications. However fragile X is the most commonly known cause of autism so far identified (http : // www.eziniarticle.com/? The-definition-for-autism-spectrum-Disorder id – 1679723).

A study by Joshi (2007) who has been tracking a group of children since birth, suggests that children who have faced exposure to higher levels of testosterone in the womb may develop autistic traits.

Autism is linked to an underlying medical condition like metabolic disorder (untreated phenyl-ketonuria), congenital infections, (rubella, cytomegalovirus , toxoplasmoris), genetic disorders, developmental brain abnormalities (microcephaly and macrocephaly) and neurologic disorders acquired after birth (lead encephalopathy, bacterial meningitis) (www.emedicinehealth.com).

Chugani et al. (1999) implicated serotonin dysfunction as a possible factor in the genesis of autistic disorder. Hyperserotonemia is a robust finding in autistic disorders and has been consistently replicated.

Bachevalier (1994) have found evidence for differences in the hippo campus and amygdala. He noted increased cell packing and diminished neuronal size in the hippo campus and some nuclei in the amygdale. They also found decreased

complexity and extent of dendritic arbors in hippo campal pyramidal cells. They speculated that such lesions might produce changes in behaviour similar to those with Kluvey Bucy syndrome and limbic injuries leading to memory loss.

The key finding in autism risk is the leptic resistance (high levels of leptin in the blood signifying low levels in the brain) which causes brain inflammation and increased risk for excite toxic brain cell damage. There is evidence of both immune dys-regulation and auto immune phenomena in children with autism spectrum disorders (ASD) (www.wellnessresources.com).

Adams (2001) has found unusual proteins and peptides in the urine of people with autism. Those proteins and peptides come from casein (dairy) and gluten (wheat and related grains) and they have an opionids like effect on the brain. The peptides enter the blood due to two major biological flaws – one is a failure of the digestive track to fully digest or break down the casein and gluten molecules into amino acids, another is a "leaky gut" which allows the undigested peptides to pass into the blood stream.

Various animal model researchers have proved that, during the critical period of foetal development, maternal prenatal stress and the neuro-endourine response against stress causes permanent changes in the foetal brain (Takahashi et al., 1992).

Milberger and Colleagues (1997) found that long-term exposure to haemorrhage, smoking, domestic problems and illicit drug use during pregnancy are important influential factors of perinatal complication.

The mercury preservative in vaccine has been hypothesized as a cause for autism and related developmental disorder. Higher doses of vaccine given earlier would cause more problem and that infants born preterm would be smaller in size and has the higher risk (Andrew et al., 2004 and Heron et al., 2004).

Leekam et al. (1998) point out those children with autistic disorder show several kinds of impairment in social relationship, communication and activities. Their social interactions are unusually high. In general, such children have a noticeable lack of awareness of the existence of feeling of others. Communication impairment is even more dramatic than impaired social behaviour in autism. About

half of all autistic children do not develop speech at all. Autistic children have a very narrow range of interest and activities. They may spend great deal of time spinning objects, flicking their finger or twisting or rocking their bodies. As they grow older, children may spend their time repetitively feeling or smelling objects or lining up items in a row.

Children with autistic disorder shows less contact seeking and contact maintaining with their mothers than normal children, at the same time they demonstrate a clear preference for their mother over a stranger (Ijzendoorn et al., 2007).

According to Peterson et al. (2005) children and adolescents with autism, spend more time alone on the outskirt of the peer group and less time in interaction with the peer group.

Plaisted et al. (1998) frequently observed that individuals with autism show poor transfer of newly acquired skills on knowledge from a training context to a novel environment and parents of individuals with autism often comment that the behaviour of their children at school or in structured educational environment can be quite unlike their behaviour at home.

Bennetto et al. (1996) stated that individuals with autism have a primary deficit in working memory that refers to the simultaneous processing and storage of information during complex cognitive tasks. Working memory is so severe and occurs early enough in development that it interferes with the child's ability to engage in other development tasks such as irritation and inter subjective.

The evidence that children with autism have impaired theory of mind tasks that include picture sequencing, second-order false belief in comparison to the performance of children with Down's syndrome was reported by Ziatas et al. (1998).

Dawson et al. (2002) determined that even on simple attention tasks such as orienting to auditory stimuli children with autism are less likely to orient to social stimuli (eg. Clapping) than to non-social stimuli (eg. a rattle).

Katarzyna et al. (2003) suggested that symptoms of autism in infants and toddlers cluster around early emerging social communicative behaviours. These include deficit in visual joint attention as one of the most robust indicator of autistic psychopathology in early childhood.

Children with autism do not distinguish well between objects and people and also behaviour between people. They do not perceive peoples' feeling and appear to lack empathy. They fail to develop a sense of one self or personal agency (Russell, 1996) In the same way they do not develop the concept of others and their 'selves' as described by Frith (1989) in the concept of 'theory of mind' (Jordon, 2000).

In autistic syndrome, urinary peptide abnormalities derived from gluten, gliadin and casein are reported (ann.mari.knivsberg@slf.his.no).

Other characteristics of the syndrome given by American Psychiatric Association (1994) are:

Social interaction	Qualitative interaction, as manifested by atleast one of the impairment of the following • Marked impairment in the use of multiple non-verbal behaviours (eg. eye to eye gaze). • Failure to develop peer relationship appropriate to developmental level. • Lack of spontaneous seeking to share enjoyment with other people. • Lack of social or emotional reciprocity.
Communication	Qualitative communication as manifested by atleast one of the impairments of

	following : • Delay-in, or total lack of the development of spoken language. • Marked impairment in initiating or sustaining a conversation with others in individuals with adequate speech. • Stereotyped and repetitive use of language or idiosyncratic language. • Lack of varied spontaneous make-believe or imitative play.
Behaviour	Restrict, stereotyped patterns of behaviour, as manifested by one repetitive and of the following : • Preoccupation with one or more stereotyped or restricted patterns of interest. • Adherence to non-functional routines or rituals. • Stereotyped and repetitive motor mannerisms. • Persistant preoccupation with parts of objects.

People with autism may be selective eaters which may put them at risk for some vitamin and mineral deficiencies (www.ncpad.org). Behaviour which are found to be related to diet can include:

- Rigid food choices – eating less or fewer foods
- Rigid food rules
- Pica

- Pallor, shiner under the eye (www.nutritionandautism.com)

B. PROBLEMS FACED BY AUTISTIC CHILDREN

Researchers often report that children with autism have hypersensitivity to sensory stimuli, such as sensitivity to bright lights, loud noises, specific fabrics or unique flavours or food textures (Wiggins et al., 2009).

According to Hoffman et al. (2006) sleep problems are often seen as a clinical feature associated with autism and children with autism are reported to have more sleep disturbances than typically developing children. People with autism-related disorders are less likely to make irrational decisions and are less influenced by gut instincts (Science Daily, 2008).

A new study carried out by National Institute of Mental Health (2008) examined the characteristics of children who have pervasive development disorder (PDD). They concluded that the gastrointestinal problems such as reflux, stomach pain, bloating, food intolerance, constipation or diarrhea are common in these children with PDD or associated with specific characteristics of PDD.

Boucher et al. (1998) had observed that the ability of children with autism to recognise and to understand facial expression is impaired. The ability to integrate visual and auditory aspects of facial speech and the ability to infer meaning from the direction of gaze are also impaired. However the ability to judge the direction of looking is not impaired.

According to the study carried out by Susan et al. (1998) children with autism are found to have difficulties engaging in shared attention with others. This problem is considered to be a central part of the disorder children and may use non-visual information to support joint attention and hence aid language development.

Proponents of the gluten-free diet say that many children with autism have gastro intestinal difficulties that make it hard for them to digest certain grains properly. There are different possibilities or ways in which this could affect children with autism like reduced desire for social interaction, block pain messages and

increased confusion. (http: // autism. Healing thresholds.com / therapy / gluten-free-diet). Selectivity is the most common problem among children with autism spectrum disorder, although eating rituals and food refusal also occur (http : // www. Autism-help.org/Nicholls, 2001).

For years, parents of children with ASDs have anecdotally reported that their children only eat foods of one colour or texture or they will only eat foods when presented in a certain way (Schereck, 2004). These reports imply that children with ASDs consume a narrow range of food, which may put them at risk for inadequate nutrient intake.

Observations made by Buitelaar et al. (1998) infer that typically, a child with autistic disorder has abnormal patterns of eye contact and facial expression when compared with normal children. Children with autism fail consistently to maintain eye contact or vary facial expression to establish social relationship. These children seem to have considerable difficulty in effectively coordinating social cues.

Eating disorders are complex and continue to be studied among various populations. Eating disorders such as failure to thrive, rumination, pica, obesity and anorexia nervosa can affect children with autism spectrum disorder. Children experiencing these problems are at risk for serious health and growth problems that can lead to life threatening consequences (Kedesdy and Budd, 1998).

Legge (2002) defines pica, as the ingestion of non-nutritious substances. It is behaviour that can start at any point in life under various circumstances. Nutritional deficiencies, sensory stimulation, lack of ability to discriminate non-edible items and relief of anxiety are all possible factors that can lead to pica.

According to Volkmar (2005) autism can affect speech, language development and social communication in many ways. A person with autism may have the following speech problems:

- Does not talk at all
- Utter grunts, cries, shrieks or throaty, harsh sounds
- Hum or talk in a musical way
- Babble with word like sounds

- Use foreign – sounding “words” or robotic-like speech
- Echolalia

Nestor et al. (2008) suggested that children with autism have a typical visual perception and functioning like greater visual acuity, increased sensitivity to light and increased strabismus.

Autism children have shown impaired blood flow (hypo-perfusion) to the brain. Hypo-perfusion may contribute to functional defects not only by inducing hypoxia but also by allowing for abnormal metabolite or neurotransmitter accumulation (http: // www.translational medicine.com).

Ichim (2007) hypothesised that children with autism have immune system that do not function normally; instead an auto immune response of the nervous system appears to prevail. Immune dys-regulation is very apparent in most of the autistic children.

Kanwar (2006) identified that children with autism will exhibit problems like oversensitivity or under reactivity to touch, movement, sights or sounds ; physical clumsiness or carelessness ; poor body awareness ; a tendency to be easily distracted ; impulsive physical or verbal behaviour ; not calming oneself ; difficulty in learning new movement ; specific learning difficulties or delays in academic achievement.

William (2004) and Muthu (2008) reported that autistic children commonly have damaging oral habits such as bruxism, tongue thrusting, picking at the gingiva, lip biting and pica. Sleep disorders in children with autism are frequently reported by their parents. Parasomnias such as sleep walking and nightmares were among the least frequently reported sleep problems. Bruxism (non-functional, involuntary, forceful grinding of teeth) is found to affect 10-20 per cent of the population.

Individuals with autism, especially children present challenging behaviour like tantrums and destructive behaviour. Tantrums are one of the most common problems in young children with autism. They may appear to go into a stage or rage, panic, anxiety or fear for no reason at all. It might also involve screaming, crying, resisting contact with others or pushing others away. Challenging behaviour intends to suggest

that behaviour present a challenge to professionals and services (http : // www / slc. servier.org / autbeha.html).

C. TREATMENT FOR AUTISM DISORDER

Children with autism spectrum disorder (ASD) often have impaired communication, problems with social interaction, repetitive and stereotyped patterns of behaviour. While most research has attempted to treat the behavioural deficits commonly associated with ASD, few studies have attempted to improve the core features of this disorder. A recent study by National Institute of Mental Health (NIMH) (2002) found that donepezil HCL helped to improve speech production, attention span and ability to express emotions in a group of children with autism.

Pyridoxine (vitamin B6) was first used with children diagnosed with "autism syndrome" when speech and language improvement was observed in some children as a result of large doses of B6. A number of studies attempted to assess the effects of vitamin B6. Magnesium was found to reduce undesirable side effects on characteristics such as verbal communication, non-verbal communication, interpersonal skills and physiological function in individuals with autism (Nye, 2009).

Risperidone is a drug prescribed for schizophrenia and other mental problems. According to a recent study it can cure many of the behavioural problems in children with autism. Only haloperidol had been considered to be superior for the treatment of serious behavioural problems although it causes excessive sleepiness in a large percentage of the autistic children who receive it. In comparison, risperidone was found to be safe, effective and well tolerated for the short term treatment of tantrums, aggression and self-injurious behaviour in these children and could be considered a drug of choice (http : // doctor.ndtv.com).

Hyperactivity, poor attention span and impulsivity are often prominent associated clinical features and have been target symptoms in previous medication trials. An adverse response of autistic children to dextroamphetamine has been reported. An open trial by Cohen et al. (2003) suggested that methylphenidate use in autistic hyperactive children may ameliorate hyperactivity and impulsivity in the

autistic children. Neuroleptics are also effective in reducing in attention in children with autistic children.

Speech therapy can improve overall communication. Specific goals of speech therapy include helping the individual with autism to:

- Articulate words well
- Communicate both verbally and non-verbally
- Initiate communication without prompting from others
- Exchange ideas
- Learn self regulation (Schechter et al., 2008).

According to Diehl (2003) the most successful approaches to speech therapy include: early identification, family involvement and individualized treatment. The goal of speech therapy is to improve all aspects of communication. This includes: comprehension, expression, sound production and social use of language.

Children with autism may be hypersensitive or hyposensitive to certain noise, touch, smell and taste. An occupational therapist uses equipment and techniques that help a child integrate and unify the inputs derived from sense organs. This reduces the child's hypersensitivity or hyposensitivity and enables him / her to adjust well to the environment (http: // www. the national trust.in).

A new study from Science Daily (2008) and Ruddy (2008) found that children with autistic spectrum disorder who underwent sensory integration therapy exhibited fewer autistic mannerisms compared to children who received standard treatments. Such mannerism, including repetitive hand movement or actions, making noises, jumping or having highly restricted interest, often interfere with paying attention and learning.

Gold et al. (2006) observed that individual with autism show equal or increased abilities in pitch processing including memory, labeling and categorization in addition to high preference for music when compared to typically-developing

peers. Researchers established a link between music therapy and the reduction of disruptive behaviour (head-jerking, screaming) (http: // www. academom.com).

Gever (2009) suggested hyperbaric treatment for autistic individuals. This treatment which is effectively giving high concentrations of oxygen at increased atmospheric pressure has been shown to have some benefits in other neurological conditions such as foetal alcohol syndrome and cerebral palsy. After 40 hours of hyperbaric treatment autistic children showed significant improvement in social interaction and eye contact compared with controls.

Joint attention training may be especially beneficial in young, preverbal children with autism, because joint attention behaviour precede and predict social language development (Bruinema et al., 2004 and Whalen et al., 2003).

A recent randomized, controlled trial demonstrates that joint attention and symbolic play skills can be taught and these skills generalize to different settings and people (Karari et al., 2006). Families can facilitate joint attention and other reciprocal social interaction experiences throughout the day in the child's regular activities (American Academy of Pediatrics, 2005).

The use of augmentative and alternative communication modalities, including gestures, sign language and picture communication programs often is effective in enhancing communication (Goldstein et al., 2002 and Paul et al., 2005). The picture exchange communication system (PECS) is used widely (Bondy et al., 1994). The PECS method incorporates Applied Behaviour Analysis (ABA) and developmental pragmatic principles and the child is taught to initiate a picture request and persist with the communication until the partner responds. Some non-verbal people with autism may benefit from the use of voice-output communication aids, but published evidence for these aids is scanty (Pual et al., 2005).

Educationally based programs are often the only form of intervension given to children with autism spectrum disorder and are often the only form of support that their family receive. Often these interventions are offered early in the child's development and there is a perception that interventions offered early are more effective than those offered later (Reed et al., 2007).

Autistic children may benefit from specific treatment program aimed at teaching social knowledge and understanding rather than an effort aimed at motivating social involvement (Bauminger et al., 2000). It is the role of professionals to provide families with the information and support they need, in order to enable them to identify problems at an early stage and to help them evolve management strategies that will mimimise the impact of the child's social, communicative and obessions problems in later life (Howlin, 1998).

D. NUTRITIONAL THERAPY FOR AUTISM

Nutritional status or nutriture is the condition of health of an individual as influenced by nutrient intake and utilization in the body (Sunita and Jain, 2005). Supplements or diets are often used to alter physiology in an attempt to relieve common autistic symptoms such as seizures, sleep disturbance, irritability and hyperactivity (Levy and Hyman, 2005).

Burrower (2008) defines exclusion diet as those that eliminate certain foods that may irritate the intestine. Elimination diets can be used to identify problematic foods, the diets are time consuming to follow and require record keeping, discipline and motivation. An elimination diet functions as a test to determine whether the patient has sensitivity to specific foods. Patients should be vigilant to replace any nutrient missing from their restricted diet.

Feingold (1975) hypothesized that food additive, in particular artificial flavours, colours and naturally occurring salicylates were associated with learning disabilities and hyperactive behaviour in some children. Children, demonstrate increased behavioural symptoms when challenged with artificial flavours, eg. tartrazine and propionate. Hence the Feingold diet involves eliminating artificial colourings, flavourings, preservatives and nitrates (Myer and Johnson, 2001).

Several investigators have broadened Feingold's original hypothesis to restrict not only food additives and dyes, but also sugars, dairy products, wheat, corn, nuts, eggs, chocolate and other foods that commonly cause allergic reactions in children. These studies have reported improvements in behaviour symptoms associated with ADHD after 2-3 weeks on the experimental diet. Other investigators have utilized

more controlled research designs to assess the effect of the high restrictive oligoantigenic diet (OAD), devoid of known food allergens (Fojkar et al., 1997).

One of the approaches to treat the symptoms of autism involves vitamin supplements. The most commonly used vitamin is the B complex which helps the brain to create enzyme that aid in its functioning. Vitamin B-12 maintains the nervous system and many have reported that the vitamin B supplements resulted in improved eye contact, attention and behaviour for some autistic people (Reynolds, 2006).

Semon (2007) states that yeast that cause mental symptoms by releasing chemical compounds can be easily and safely treatable. The way to reverse this yeast problem is to take the anti-yeast drug-nystatin. This drug is not absorbed and kills the yeast living in the intestinal tract.

Adams and Holloway (2004) in one of their studies showed that over 30 per cent of parents were giving their children extra vitamin C and vitamin B6 and over 25 per cent were using essential fatty acids and magnesium. Other nutritional supplements reported in use by more than 10 per cent of parents include vitamin A, mega vitamin therapy, DMG (dimethylglycine) and L-glutamin. In regards to maintaining a general state of good health, the use of a daily multi-vitamin is widely accepted and supported for children with autism spectrum disorder.

Horrocks and Farooqui (2004) and Wainwright (2002) established that the essential fatty acids (arachidonic acid, eicosapentaenoic acid and docosahexanoic acid) are important in the structural and functional development and maintenance of neuronal membranes. Deficiencies in essential fatty acids have been implicated in the pathogenesis of a range of developmental and behavioural disorders, including autism spectrum disorder and Attention Deficit and Hyperactive Disorder (ADHD) (Steven et al., 2000).

Cade and Colleagues (1999) conducted a study on treatment with gluten free – casein free diet in 270 individuals. The treatment was accompanied by reports of improvement in 81 per cent of children within three months. A strength of this work was the combined use of physiological and behavioural measures.

Researches believe that individuals with autism do not have enough Essential Fatty Acids (EFAs), on that they have a poor balance of EFAs i.e. too much omega-6-fatty acids and not enough omega-3-fatty acids. This imbalance is said to cause the symptoms of autism. There is a wide range of supplements which contain essential fatty acids from a variety of sources such as borage, cod liver oil, evening primrose, flax seed, fish etc (http : // www.researchautism.net, 2006).

Dimethylglycine (DMG, a nutritional supplement) is metabolized to the excitatory neuro transmitter, glycine, within the liver. There have been reports of an old Russian study, which suggested enhanced language skills in developmentally disabled children who were administered DMG (Bolman *et al*., 1999).

Increasingly, parents are investigating supplements and alternative diet strategies, but it should be noted that food and nutrition professionals counseling their families must have access to and an understanding of and prescription medications that the child is on. American Dietetics Association's position paper on providing nutrition service to children with developmental disabilities states that the "dietetics professions' role, as an effective member of the health care team is to assess the clinical, biochemical and anthropometric measurements of the client" (American Dietetic Association, 2004).

III. METHODOLOGY

The experimental procedure adopted for the present study entitled **"Effect of introduction of elimination diet and supplementation of flax seed in autistic children (2-7 years)"**, had the following steps :

A. Selection of schools and samples
B. Formulation of tools
C. Conduct of the study
    1. Assessment of the nutrition status of children
    2. Observing the eating habits of the autistic children
    3. Supplementation of flax seed powder to selected subjects
    4. Introducing elimination diet
    5. Imparting of nutrition education
D. Data analysis and interpretation of the results

A. SELECTION OF SCHOOLS AND SAMPLES

Coimbatore and Chennai cities were selected as the areas for conducting the present investigation as the investigator was familiar to these areas. As a first step the investigator made a list of all the available institutions catering to the needs of autistic children through personal enquiries. Following were the schools identified as having autistic children:

1. You can, P.N. Pudur, Coimbatore.
2. Bharathiar Rehabilitation Centre, Thadagam Road, Coimbatore.
3. Sanjeevani Care Trust, G.N. Mills, Coimbatore.
4. Coimbatore Spastic Trust, R.S.Puram, Coimbatore.
5. We can Autism Center, Thiruvamiyur, Chennai.
6. Swabodhini, Adyar, Chennai.
7. Vidhyanjali Therapy Centre, Chennai.
8. V-excel, Adyar, Chennai.
9. Sankalp, Anna Nagar, Chennai.
10. Prashanthi, Chromepet, Chennai.

Initially all the available autistic children who were in the age group of 2 to 7 years were selected for the study from the above mentioned schools.

Table 1 points the number of autistic children available in the schools selected for the study.

TABLE – 1

SELECTION OF SAMPLES FOR THE STUDY FROM THE SELECTED SCHOOLS

S.No.	Name of the School	Number of Students
1.	You can (Coimbatore)	11
2.	Bharathi Rehabilitation Centre (Coimbatore)	14
3.	Sanjeevani Care Trust (Coimbatore)	10
4.	Coimbatore Spastic Trust (Coimbatore)	7
5.	We can (Chennai)	15
6.	V-excel (Chennai)	9
7.	Swabhodini (Chennai)	16
8.	Sankalp (Chennail)	12
9.	Vidhyanjali Therapy Centre (Chennai)	12
10.	Prashanti (Chennai)	14
TOTAL		**120**

All the 120 autistic children available were included for collecting the background details.

B. FORMULATION OF TOOLS AND COLLECTION OF DATA

To elicit the background details of all the 120 autistic children an interview schedule was formulated. The schedule included details regarding the socio-economic background, food pattern and dietary habits, morbidity pattern and prenatal history of the subjects.

The socio economic background included age, religion, type of family, family background and monthly expenditure pattern. Details on food pattern and dietary habits included the food habits, household food availability, food beliefs, 3 days diet recall, special foods given, snacking and skipping the meals, the child's activity level, period of breast feeding, weaning, type of feeding, child's appetite, relationship between child's behaviour and his / her eating habits, food allergies, problems in eating and eating frequency details. Data on morbidity pattern were collected along with the details of age when the problem was identified, specific problems, faced, treatment modalities, immunization and incidence of illness.

Details on prenatal history included data on age of mother at conception, type of delivery, complications, birth weight of the child, personal habits and Rh incompatibility.

The schedule developed was pretested on five children and required modifications were incorporated and finalised as given in Annexure – 1. Interview is a method of collecting data where the questions are asked and responses are filled in by the investigator through face to face contact (Gupta, 2004). The investigator interviewed the mothers and attenders of all the 120 children in their respective schools. She administered the questionnaire and collected the background details of the subjects. (Plate 1)

C. CONDUCT OF THE STUDY

1. Assessment of the nutritional status of the children

A nutritional assessment evalutates the client's current nutrition status and determines how the client's age, health life style and socio-economic status affect nutrient needs and the ability to understand and follow nutrition advice.(Corinne

Balog Cataldo,1999). The following parameters were employed for assessing the nutritional status of the subjects:

a. Anthropometric measurements

b. Clinical examination

a. Anthropometric measurements:

Anthropometry is the simple, most universally applicable, inexpensive and non-invasive method available to assess the size, proportion and compositions of the human body (WHO Experts Committee,1995). In the present study measurements of height, weight was taken for all subjects. Body weight and height of children reflects their state of health and growth rate (ICMR,1990).

Height:

The height of all the subjects were measured using a fibre glass measuring tape. The individual was made to stand near the wall with his/ her heel and head touching the wall, taking care to see that the floor area was even. The head was held comfortably high. A smooth thin ruler was held on the top of the head in the centre, crushing the hair at right angle to the scale and the height read off in centimeter from the lower edge of the ruler to the nearest 0.5 cm. Each reading was taken twice to ensure correctness of the measurements. (Plate 2).

Body weight:

Weight is a measurement of body mass. It is the simplest anthropometric measurement with the least individual error. A weighing scale of platform type was used for weighing the subjects as it was portable and convenient to use. The weighing scale had 0.5 kg sensitivity and checked for accuracy and adjusted to zero before weighing. The weight was taken without shoes and other heavy clothes. The subjects were asked to stand on the platform of the scale without touching anything and looking straight ahead and their weights were recorded. (Plate 2).

b. Clinical examination:

Clinical examination provides direct information of the signs and symptoms of dietary deficiencies prevalent among the people (Swaminathan, 2004). Clinical examination was carried out for all 120 children. The investigator identified the clinical symptoms of malnutrition among the selected children.

2. Observing the eating habits of the autistic children

Eating and feeding are common problems observed by the parents of young children. Many children develop mild feeding or eating problems at some points in their development. Many problems of picky eating at meal times are resolved with a little guidance and some patience (Gottschall, 2002).

The information on eating habits of the autistic children were collected with the help of the interview schedule by the investigator by observing each subject for three days for a minimum period of one hour everyday. The observations were recorded and co-related with hyper or hypo activity. Behaviours like trouble in chewing food, holding food in mouth, spitting the food, dumping foods, eating non-edibles, mouthing objects, smelling food, eating foods only in certain places, unwilling to try new foods, insisting on foods to be prepared in certain ways and frequency of consuming food items were recorded. (Plate 3).

3. Supplementation of flax seed powder to selected subjects

Omega – 3 – fatty acids are recognized as eventual fatty acids that are vital to the health but cannot be produced by the body and hence must be supplied through the diet. Extensive research suggests that these fatty acids are prominently fixed in the brain and appear to be particularly important for cognitive (brain, memory and performance) and behavioural function (www.wikipedia.org). Also omega – 3 – fatty acids may improve immune function because autistic children are said to have low immunity (Kedesdy, 1998).

Based on such findings, the investigator, planned to study the impact of supplementing flax seed powder to autistic children in terms of changes in the immunoglobulin G level of the children.

a. Procuring and processing of flax seeds

Flax seeds are available at the country shops and department stores at nominal rates. A total of 12 kg of flax seeds were brought and cleaned by sieving. The cleaned flax seeds were then dry roasted in a tava until they gave a crackling sound. Then, they were allowed to cool and processed as and when required.

b. Incorporation of flax seed powder in recipes

The flax seed powder was incorporated in various common recipes that are normally consumed or preferred by the autistic children in variations of 5, 10, 15 and 20 g per serving. These recipes are given in Annexure – IV. Initially, four autistic children were randomly selected and the acceptability of the recipes was tested among them. Each child was administered a recipe incorporated flax seed at one level for a period of one week. The acceptability of the flax seed powder was recorded and presence of side effects if any was observed.

c. Orientation and conducting the supplementation

Among 120 autistic children selected for the study, 12 children whose parents were willing to co-operate were selected as an experimental group and divided into four groups (E_1, E_2, E_3 and E4) of three children each for supplementing 5, 10, 15 and 20 g of flax seeds respectively. Three children were included as a control group (C) in this study. The parents of the children in the experimental group were given an orientation about the flax seeds, its nutritional benefits and usage in various recipes.

The powdered flax seeds were packed in clean, zip lock pouches in various quantities (5 g, 10 g, 15 g and 20 g). The packets were distributed once in a week to the experimental groups and the mothers were asked to refrigerate the powders. The mothers and the attenders were instructed to feed the powders to the subjects regularly by incorporating into recipes. (Plate 4).

d. Evaluating the impact

Under the supervision of the investigator the supplementation was carried out for 75 days. The investigator had recorded the acceptability and side effects (if any) of the flax seed powder through enquiry and recorded the response. The parameters considered for evaluating the impact of flax seed supplementation were changes in the serum immunoglobulin G levels, blood haemoglobin levels, perceived changes in symptoms of autism, activity levels and eating behaviour. For this purpose an interview schedule (Annexure –2) was used to record the changes. The interview schedule consisted of the details on activity level, eating problems and symptoms on autism. The serum immunoglobulin G levels were determined and the interview schedule was administered initially and at the end of the study. The serum immunoglobulin G levels were tested by immunoturbidimetry method and blood haemoglobin levels by cyanmethaemoglobin method (given in Annexure –3 and 4). The changes in the serum levels of immunoglobulin G, activity level and behaviour of both experimental and control group children were observed.

4. Impact of elimination diet

Studies on dietary intervention in autistic syndrome reported that autistic individual suffer from “leaky gut” disorder where they won’t have the ability to digest certain proteins (casein and gluten) present in the food. Improper digestion of such proteins may result in gastrointestinal problems and urinary peptide abnormalities. Such complications are said to be connected with impaired social interaction, communication and imaginative skills (Knivsberg, 2001). During digestion of proteins like gluten and casein, a number of peptides are produced which have similarities to opiate drugs such as morphine and heroin. There peptides could have various powerful effects in the brain and nervous system. Hence gluten and casein proteins need to be eliminated from the diet of the autistic children.

Ten children for the elimination diet were selected based on their activity level which is assessed through the administration of the sensory integration inventory schedule by the occupational therapist to the parents of the children. Both hyper and hypo activity level children were included. The ten children were divided randomly into two groups of five children each to be treated as experimental and control groups.

The investigator met the parents of the selected autistic children in their respective schools and educated about the need for the elimination of gluten and casein from the diet. The parents were asked to follow the diet for three months. The parameters used to check the impact of the elimination diet were the interview schedule as given in Annexure –2 and the follow up of this study was done by recording the food intake of the individual children through 3 days diet recall method at the initial and final period of the study. The quantity of nutrients taken by the children was then calculated.

5. Impact of nutrition education

The parents of 22 autistic children selected for this study out of 120 autistic children were assessed for the level of awareness on autism. A schedule, formulated (Annexure – 5) to assess the knowledge of the parents was composed of objective type questions on autism, elimination diet and omega – 3 – fatty acids. This was administered before and after the education to the parents.

The investigator had developed a booklet for educating the parents on "Diet and autism" (Annexure 6). It is composed of information about autism, its causes, symptoms, treatment and nutritional therapy. The investigator had specified on the elimination diet and effect of flax seed powder. Ten recipes were developed with the incorporation of flax seed powder and incorporation of flax seed powder standardised through sensory evaluation (Plate 5). These were, ragi idly, ragi dosa, flax seed vada, green gram dhal, vegetable soup, vegetable sprout, sundal, ragi drink, mint rice and beet root rice. There recipes included in the booklet were utilized for educationg the parents (Plate 6).

D. DATA ANALYSIS AND INTERPRETATION OF THE RESULTS

The data collected were consolidated, tabulated, analysed and interpreted. The impact of the elimination diet and supplementation of flax seed powder on the behaviour of the autistic children was analysed.

The research design of the study is presented in Figure 1.

IV. RESULTS AND DISCUSSION

The results of the study on **"Effect of introduction of elimination diet and supplementation of flax seed in autistic children (2-7 years)"** are discussed under the following headings:

A. Demographic profile of the selected children
B. Dietary habits of autistic children
C. Nutritional status of autistic children
D. Prenatal history of the mothers of autistic children
E. Impact of nutrition interventions and education

A. DEMOGRAPHIC PROFILE OF THE SELECTED CHILDREN

Age, sex, religion and type of family of the selected children with autism is given in Table – II.

TABLE – II

DEMOGRAPHIC PROFILE OF CHILDREN WITH AUTISM

Details	Number	Per cent
Age (In years)		
1 – 5	68	56.7
6 – 10	42	35
11 – 15	10	8.3
Total	**120**	**100**
Sex		
Female	23	19.2
Male	97	80.8
Total	**120**	**100**
Religion		
Hindu	110	91.6
Muslim	5	4.2
Christian	5	4.2
Total	**120**	**100**
Type of family		
Joint	15	12.5
Nuclear	105	87.5
Total	**120**	**100**

Table II reveals that, out of 120 autistic children selected for the study, 56.7 per cent were between the age group of 1-5 years, 35 per cent were between 6-10 years and 8.3 per cent were between 11-15 years. The number decreased as the age increased, which may be due to the fact that autism is diagnosed at the early stage.

Once the child reaches his / her full potential he / she is put in regular school or in vocational training (Schechter, 2008).

Among the selected autistic children 97 were males and 23 were females. This indicated that boys are at higher risk for autism than girls. They are four times more prone to autism than girls. Similar findings were reported by Mayo clinic (2001) which stated that boys are affected with the disorder more often than girls at a rate of 4 to 1.

Among the children studied, 91.6 per cent were Hindus and rest were Christians and Muslims. Religion was found to have no influence in mental development of the children

Based on census of India data, the percentage of joint families in Indian households had declined from 20 (1981) to 18 per cent (2001). Simultaneously the percentage of nuclear families had risen from 68.10 to 70.2 per cent indicating more and more Indian adults are staying away from their parents. Similarly in this study, majority of the subjects (87.5%) belonged to nuclear family and 12.5 per cent belonged to joint family system. The type of family did not seem to have any relationship with the prevalence of autism in children

i. Age wise Distribution of Family Members

Age wise distribution of the family member of the autism children is given in Table –III.

TABLE – III

DISTRIBUTION OF FAMILY MEMBERS ACCORDING TO THEIR AGE

Age (in years)	Female		Male		Total	Per cent
	Number	Per cent	Number	Per cent		
0-10	34	14.9	99	31.3	133	24.4
11-20	10	4.4	36	11.4	46	8.4
21-30	42	18.3	40	12.7	82	15
31-40	124	54.1	122	38.6	246	45.1
Age (in years)	**Female**		**Male**		**Total**	**Per cent**
	Number	**Per cent**	**Number**	**Per cent**		
41-50	7	3.1	12	3.8	19	3.5
> 50	12	5.2	7	2.2	19	3.5
Total	**229**	**100**	**316**	**100**	**545**	**100**

According to several policy commitments made by the government at the National and International levels in 2009, India has 375 million children more than any other countries in the world (http : //info changeindia.ord / children). The prevalence rate of autism nation wide is approximately four million (Rohan, 2008).

Among the family members of the autistic children, 45.1 per cent were in the age group of 31-40 years. This group consisted of 124 females and 122 males. This group was followed by 24.4 per cent belonging to the age group of 0-10 years. Only 3.5 per cent of the total family members were between 41-50 years and above 50 years each. The total population had a maximum of males, who were 316 in number than females who were 229 in number.

2. Educational Status

The educational status of the family members are given in Table – IV.

TABLE – IV

EDUCATIONAL STATUS OF THE FAMILY MEMBERS

Educational status	Female		Male	
	Number	**Per cent**	**Number**	**Per cent**
Primary school	10	4.4	7	2.2
Middle school	3	1.3	4	1.3
High school / Higher Secondary school	109	47.8	31	9.8
Graduation, Post Graduation and Professionals	77	33.8	173	54.7
Special school	23	10.1	97	30.7
Illiterate	6	2.6	4	1.3
Total	**228**	**100**	**316**	**100**

It was found that 47.8 per cent of female members had their higher education followed by 33.8 per cent of female who had completed the graduation. Around 1.3 per cent of females had their education upto middle school. Among males, 30.7 per cent were undergoing special education followed by 21.5 per cent of males having their graduation and 54.7 per cent of male were professionally qualified. It was also seen that 2.6 per cent of females and 1.3 per cent of males were illiterates. Among females only one child was not going to school.

3. Occupation and Monthly Income of the Families

Occupation of the head of the families and monthly income as per the classification of HUDCO (2004) is presented in Table – V.

TABLE – V

OCCUPATION OF THE HEAD OF THE FAMILIES AND MONTHLY INCOME

Details	Number	Per cent
Occupation		
Business	43	35.8
Professional	37	30.8
Private employee	22	18.3
Government jobs	18	15
Total	120	100
Income levels(Rs. / month)*		
< 4500 (Low income)	-	-
4501-7500 (Middle income)	31	25.8
> 7501 (High income)	89	74.2
Total	**120**	**100**

*HUDCO (2004) Classification

Among the fathers 35.8 per cent were doing business and 30.8 were professionals. While 18.3 per cent of them were working in private sectors, only 15 per cent were government servants.

Table V reveals that 74.2 per cent of the children belonged to high income group and 25.8 per cent to middle income. This indicates that prevalence of autism is more common among the high income group.

4. Monthly expenditure pattern

The monthly expenditure of the families is presented in Table – VI.

TABLE – VI
MONTHLY EXPENDITURE PATTERN OF THE FAMILIES

Items	Percentage of income	Number	Per cent
Food	< 25	3	2.5
	25-50	93	77.5
	51-75	24	20
Clothing	≤ - 10	108	90
	11-20	12	10
Shelter	≤ - 10	82	68.3
	11-20	2	1.7
	> 20	36	30
Education	≤ 10	22	18.3
	11-20	98	81.7
Medicine	≤ 5	98	81.7
	> 5	22	18.3
Fuel	≤ 5	64	53.3
	> 5	56	46.7
Transport	≤ 5	74	61.7
	> 5	46	38.3
Repayment of debt	≤ 5	111	92.5
	> 5	9	7.5
Entertainment	≤ 5	100	83.3
	> 5	20	16.7
Saving	≤ 5	9	7.5
	> 5	111	92.5
Others	≤ 5	37	30.8
	> 5	83	69.2

It was found that majority of the families (77.5 %) spent 25-50 per cent of their total income on food. The expenditure towards clothing was less than 10 per cent among 90 per cent of the families. Greater percentage of the families (68.3 %) spent less than 10 per cent of their income on shelter. More than 80 per cent of the families spent 11-20 per cent of the total income on the education. Around 81.7 per cent spent less than five per cent of their income on medicine and 53.3 per cent less than five per cent of their income on fuel and light, 38.3 per cent spent greater than five per cent on transport, 92.5 per cent of the families spent less than five per cent of their income on loan and 16.7 per cent spent greater than five per cent on entertainment. More than five per cent of the total income was under savings in 92.5 per cent of the families. More than five per cent of the income was spent on purchase of durable good and others by 69.2 per cent of the families.

B. DIETARY HABITS OF AUTISTIC CHILDREN

Out of the 120 children studied, 52 per cent were found to be non-vegetarian, 42 per cent were vegetarian and the rest were ova-vegetarian.

1. Frequency of Consumption

Frequency of eating different foods by the children with autism is given in Table – VII.

TABLE – VII

FREQUENCY OF EATING DIFFERENT FOODS

Food items	Eating frequency									
	Daily		4-6 times/week		3-4 times/week		once in a week		Never eaten	
	No	%	No	%	No	%	No	%	No	%
Cereals										
Rice	120	100	-	-	-	-	-	-	-	-
Wheat	2	1.7	32	26.6	27	22.5	34	28.3	25	20.8
Pulses										
Black gram dhal	102	85	9	7.5	7	5.8	2	1.7	-	-
Green gram dhal	21	17.5	6	5	52	43.3	41	34.2	-	-
Bengal gram dhal	-	-	62	51.7	13	10.8	35	29.2	3	2.5
Red gram dhal	111	93	7	5	-	-	3	2	-	-
Vegetables										
Green leafy vegetables	-	-	-	-	56	46.7	57	47.5	7	5
Roots and tubers	111	93	6	5	3	2	-	-	-	-
Other vegetables	118	99	2	1	-	-	-	-	-	-
Butter, fats and oils	120	100			-	-	-	-	-	-
Fruits	71	59.2	5	4.2	40	33.3	4	3.3	-	-
Fleshy Foods										
Egg	-	-	-	-	11	9.2	59	49.2	50	41.7
Mutton	-	-	-	-	9	7.5	51	42.5	60	50
Chicken	-	-	-	-	-	-	65	54.2	55	45.8

Food items	Eating frequency									
	Eating daily		Eaten 4-6 times/week		Eaten 3-4 times/week		Eaten once in a week		Never eaten	
	No	%	No	%	No	%	No	%	No	%
Fish	-	-	7	5.8	35	29.2	20	16.7	58	48.3
Others	-	-	-	-	-	-	3	2.5	117	97.8
Milk and Milk Products										
Milk	120	100	-	-	-	-	-	-	-	-
Buttermilk	-	-	-	-	89	74.2	29	24.2	2	1.6
Curd	4	3.3	-	-	12	10	92	76.7	12	10
Sugar and Jaggery	120	100	-	-	-	-	-	-	-	-
Beverages										
Tea	88	73.3	27	22.5	5	4.2	-	-	-	-
Coffee	120	100	-	-	-	-	-	-	-	-
Baked Foods										
Biscuits	103	85.8	14	11.7	3	2.5	-	-	-	-
Bread	-	-	14	11.7	15	12.5	91	75.8	-	-
Preserved Food										
Jams	-	-	20	16.7	7	5.8	79	65.8	14	11.7

Regarding eating frequency, cent per cent of the subjects consumed rice, milk, oil, sugars and coffee daily and 28.3 per cent consumed wheat only once in a week. Daily consumption of black gram dhal (85 %) in form of idly, dosas and red gram dhal (93 %) in the form of sambar was noted. Green leafy vegetables were consumed for 3-4 times per week by 46.7 per cent of the children. Maximum uptake of roots and tubers (93%) and other vegetables (99%) daily was observed. Around 59.2 per cent of children consumed fruits like banana, tomato on daily basis and 33.3 per cent of

children consumed fruits only 3-4 times in a week. Fleshy foods like mutton (42.5%), egg (49.2%), chicken (54.2%) and fish (16.7%) were taken once in a week.

Baked foods like biscuits were consumed by 85.8 per cent of the children regularly and preserved foods like jams were taken along with bread only once in a week by 65.8 per cent of the total autistic children.

2. Infant Feeding Practices

Details regarding period of breast feeding, age of weaning and introduction of supplementary foods to the autistic children was elicited from their mothers and the results obtained are presented in Table – VIII

TABLE – VIII

INFANT FEEDING PRACTICES FOLLOWED FOR THE CHILDREN

Details	Number	Per cent
Duration of breast feeding		
< 6 months	18	15
6-12 months	41	34.2
> 12 months	61	50.8
Total	**120**	**100**
Age of weaning		
< 6 months	12	10
6-12 months	108	90
Total	**120**	**100**
Weaning foods given		
Cereals and pulses	120	100
Fruits and vegetables	110	91.7
Commercial foods	98	81.7

Table continued..

Details	Number	Per cent
Reasons		
Nutrition and health	101	84.2
Breast milk not sufficient	43	35.8
Doctor's advice	87	72.5

Breast feeding is said to be beneficial to the emotional development of the autistic child, since it provides a special opportunity for autistic children to experience close physical and emotional contact. Mothers of breast fed autistic children have reported that their children appeared to be more responsive, better adjusted socially, more likely to engage in imaginative play and more affectionate than their formula fed autistic peers (Land, 2001).

The Table – VIII denotes that 50.8 per cent of the mothers breast fed their child for more than a year and only 15 per cent breast fed for less than six months.

Regarding introduction of weaning foods, 90 per cent of the mothers of autistic children introduced the weaning foods between 6-12 months. Cent per cent of mothers provided cereals and pulses as weaning food in form of idly, gruel and chappaties, 91.7 per cent gave fruits and vegetables and 81.7 per cent of mothers gave commercial foods at the time of weaning their children.

Milk and wheat form the main weaning foods for babies. They also become the main foods for the pathogenic microbes that produce toxins. Hence more autism symptoms are seen among the infants (Natasha, 2000). Around 84.2 per cent of mothers introduced weaning foods for better nutrition and health of their children whereas 72.5 per cent introduced such foods on doctor's advice.

3. Consumption of Special Food, Snacks and Skipping the Meals

Details on special foods, snacking between meals and skipping the meals are presented in Table – IX.

TABLE – IX

DETAILS ON SPECIAL FOODS, SNACKING BETWEEN MEALS AND SKIPPING THE MEALS

(N = 120)

Details	Number	Per cent
Special foods		
Pulse mix kanji	9	7.5
Ragi and pulse mix	6	5
Commercial food	21	17.5
No special food	84	70
Total	**120**	**100**
Snacking between meals		
Takes snacks	96	80
Does not take snacks	24	20
Total	**120**	**100**
Skipping the meals		
Skips the meals	36	30
Does not skip the meals	84	70
Total	**120**	**100**

About 17.5 per cent of autistic children were given commercial foods like protein mix, horlicks and complan and 7.5 per cent consumed pulse mix kanji and 70 per cent of the children did not take any special food.

Studies carried out by Keen (2007) suggest that autism is triggered by the consumption of commercial foods that contain preservative and food additives. About 80 per cent of the children snack between meals and 30 per cent skip meals either due to lack of appetite or apathy.

4. Type of Feeding and Child's Appetite

Type of feeding and appetite of the autistic children are given in Table – X.

TABLE – X

TYPE OF FEEDING AND CHILD'S APPETITE

Details	Number	Per cent
Type of feeding		
Demand feeding	18	15
Timely feeding	102	85
Total	**120**	**100**
Child's appetite		
Poor for all foods	8	6.7
Good for those foods he / she likes	34	28.3
Good for most foods	78	65
Total	**120**	**100**

The prevalence of feeding problems among children with autistic spectrum disorders is estimated to be atleast 13 per cent. Research studies describe feeding patterns like demand feeding and feeding on time (Badalyn, 2009). Similarly about 85 per cent of the mothers reported that their children were fed on demand and rest followed timely feeding. It was also found that most of the children (65 %) had good appetite for most of the foods. Only 6.7 per cent of children had poor appetite as they consumed snacks.

5. Factors Influencing Child's Food Selectivity

The factors influencing the child's selectivity of foods are presented in Table – XI.

TABLE – XI

FACTORS INFLUENCING CHILD'S SELECTIVITY OF FOODS

(Multiple response)

Factors	Number	Per cent
Taste	21	17.5
Texture	11	9.2
Temperature	4	3.3
Smell	29	24.2
Appearance	3	2.5
Nil	78	65

Legge (2002) observed that some children with autism spectrum disorder have strong preference for one particular texture of food and are more affected by the smell of food. Likewise, it was found that 24.2 per cent of children's selectivity of food was affected by smell and 17.5 per cent children ate very tasty foods. Only a few children (2.5%) selected food based on their appearance and 65 per cent of the autistic children were not affected by such factors.

6. Problems Affecting Child's Eating Behaviour

Problems affecting the child's eating habits are illustrated in the Table – XII.

TABLE – XII

PROBLEMS AFFECTING THE CHILD'S EATING HABITS

(N = 120)

Problems	Number	Per cent
Ear infection	3	2.5
Medication	4	3.3
Asthma	10	8.3
Seizure	7	5.8
Hospitalization	2	1.7
Dental caries	8	6.7
Presence of food allergy	27	22.5
Nil	86	71.7

In this study, 28.3 per cent of parents believed that health problems in their child affected eating patterns. Common health problems included ear infection (2.5 %), asthma (8.3 %), seizure (5.8 %) and a history of hospitalization (1.7 %). A statistical association was identified between the presence of gastro esophageal reflux and difficulties in taking medications (Zachor, 2006). Accordingly 1.7 per cent of children had a history of hospitalization, 3.3 per cent faced problems in taking medicine and 22.5 per cent of parents had complaints of presence of food allergies towards milk, wheat and certain fruits (banana) among their children.

7. Types of Eating Problems

Type of eating problems faced by the autistic children is given in Table – XIII.

TABLE – XIII

EATING PROBLEMS AMONG AUTISTIC CHILDREN

(Multiple response)

Eating problems	Number	Per cent
Smelling objects	45	37.5
Spitting foods	44	36.7
Mouthing objects	35	29.2
Eating foods only in certain places	31	25.8
Dumping / throwing food	30	25
Holding food in mouth / cheeks	27	22.5
Unwilling to try new foods	26	21.7
Eating non-edible	21	17.5
Requiring foods to be prepared in certain way	12	10
Trouble in chewing food	11	9.2
Others	5	4.2
Absence of eating problems	11	9.2

A wide array of problem behaviour was reported by Seroussi (2000). Frequently observed oral or eating behaviour included trying new foods, taking medicine and ritualistic surrounding eating.

In this study, the most often observed eating problems were, smelling objects or food (37.5 %) and spitting foods (36.7 %), followed by eating food in certain places (25. 8 %) and dumping or throwing food (25 %). Around ten per cent of children required foods to be prepared in a specific way and 9.2 per cent of children had trouble in chewing food. Only 11 of autistic children did not have any eating problems.

8. Food Believes

The mothers entertained several foods believe which led to inclusion or exclusion of foods in the diet of family members. According to Swaminathan (2005), food fads and faulty food habits are the important contributory causes for the wide prevalence of malnutrition among vulnerable groups in developing countries. These can be overcome only by nutrition education. Food beliefs of the mothers of the autistic children are given in Table XIV.

TABLE – XIV

FOOD BELIEFS OF THE MOTHERS OF AUTISTIC CHILDREN

(Multiple response)

Details	Number	Per cent
Hot foods		
Coffee / Tea	4	3.3
Mango	3	2.5
Spicy foods	11	9.1
Cold foods		
Tender coconut water	12	10
Cucumber	17	14.1
Fruit	14	11.6
Gas producing foods		
Raw banana	11	9.1
Potato	21	11.6
Bile producing foods		
Spicy foods	8	6.6
Coffee / Tea	7	5.8

Table continued..

Details	Number	Per cent
Foods causing skin disease		
Brinjal	41	34.1
Yam	16	13.3
Foods causing colic pain		
Potato	7	5.8
Bitter gourd	2	1.6
No belief	24	20

A maximum of nine per cent of mothers considered spicy foods as hot foods. Coffee, tea and mango were also considered as hot foods.

Cold foods as reported by the families included tender coconut water, cucumber and fruits. They were believed to lower the body temperature leading to cold, sore throat and fever.

Raw bananas and potatoes were considered to produce gas by nine per cent and 18 per cent of the families respectively.

Spicy foods and beverages like coffee and tea were believed to produce bile. Around 34 per cent of the families considered yam for the same reason. Vegetables like potatoes and bitter gourd were believed to cause colic pain.

It is observed that the food believes of the families were similar to the ones commonly prevailing in the community and already reported findings also indicate the same.

9. Activity Level

The current activity levels of autistic children are given in Table – XV.

TABLE – XV

CURRENT ACTIVITY LEVEL OF AUTISTIC CHILDREN

Activity level	Number	Per cent
Extremely active	19	15.8
Very active	38	31.7
Moderately active	35	29.2
Active	22	18.3
Quiet	4	3.3
Lethargic	2	1.7
Total	**120**	**100**

Judging the activity level of autistic children is very important. These children activity normally ranges from extremely active to totally lethargic. Based on such activity level food habits of children changes and modification of their dietary habits become easier or difficult.

Responses to current activity level indicated that 31.7 per cent of the parents considered their children to be very active and 29.3 per cent were considered to be moderately active. Around 15.8 per cent were judged to be extremely active and only 1.7 per cent were considered to be lethargic.

C. NUTRITIONAL STATUS OF THE AUTISTIC CHILDREN

1. Mean Height and Weight of Autistic Children

Mean height and weight of the selected autistic children is given in Table XVI.

TABLE – XVI

MEAN HEIGHT AND WEIGHT OF THE AUTISITIC CHILDERN

(N = 120)

Parameters	Age (in years)	Male			Female		
		NCHS standards	ICMR standards	Mean ± S.D	NCHS standards	ICMR standards	Mean ± S.D
Height (cm)	1-3 (m=) (f=)	88.78	84.91	86.16 ± 1.43	86.83	82.82	84 ± 0
	4-6 (m=) (f=)	111.26	107.32	105.61 ± 4.4	109.81	105.9	106.14 ± 2.60
	7-9 (m=) (f=)	128.28	128.26	119.76 ± 6.69	127.87	127.26	120.81 ±6.08
Weight (kg)	1-3 (m=) (f=)	13.15	11.50	12.5 ± 0.41	12.38	10.81	11.5 ± 0
	4-6 (m=) (f=)	19.2	17.7	16.51 ± 1.65	18.69	17.01	16.45 ± 1.35
	7-9	26.11	26.96	21.71 ± 2.63	25.91	26.86	22.17 ± 198.

As per the classification of NCHS standards (2002) and ICMR standards (2004).

As perceived from the Table – XVI, the mean height of males and females were below the NCHS and ICMR standard values. Only the mean height and weight of both male and female were above ICMR standard values. In general boys were taller than girls.

2. Haemoglobin Levels

Distribution of children according to their blood haemoglobin levels is given in Table XVII.

TABLE – XVII

DISTRIBUTION OF CHILDREN ACCORDING TO BLOOD HAEMOGLOBIN LEVELS

Haemoglobin levels	Number
12 g / dl and above (non-anaemic)	1
10-11.9 g /dl (mild anaemic)	3
7-9.9 g / dl (moderate anaemic)	7
< 7 g / dl (sever anaemic)	4
Mean ± S.D.	**8.18 ± 2.26**

The blood haemoglobin levels were tested for 15 samples who were selected for the supplementation of flax seed powder. Out of the 15 children, one child had the haemoglonbin level more than 12 g / dl (non-anaemic) and the rest had less than 12 g / dl indicating that 14 children were anaemic out of whom three had mild anaemia (10-11.9 g / dl) and seven had moderate anaemia (7-9.9 g /dl). Severe anaemia was found among four autistic children. The mean haemoglobin level was found to be 8.18 g / dl.

3. Clinical Symptoms of Nutritional Deficiency

Signs and symptoms of nutritional deficiencies is given in Table – XVIII.

TABLE – XVIII

SIGNS AND SYMPTOMS OF NUTRITINAL DEFICIENCIES

(Multiple response)

(N = 120)

Clinical signs	Number	Per cent
Poor musculature	43	35.8
Tenderness of calf	25	20.8
Dental caries	23	19.2
Deficient subcutaneous fat	14	11.7
Discoloured / dry / sparse / brittle hair	7	5.8
Dry / rough skin	3	2.5
Mild anaemia	3	1.5

Table – XVIII reveals that 35.8 per cent of the children who were autistic had poor musculature and 20.8 per cent had tender calf muscle. Dental caries was found among 19.2 per cent of children followed by deficient subcutaneous fat in 11.7 per cent of total children. Other symptoms like discoloured / dry / sparse / brittle hair (5.8 %), dry / rough skin (2.5 %) and mild anaemia (1.5%) were observed. This indicated that signs and symptoms of nutritional deficiencies were a predominating feature in most of the children with autism.

4. Autistic Problems Among Children

Age of identification of autism, specific problems, immunization pattern and existence of autism in previous generation is presented in Table – XVIX.

TABLE – XVIX

DETAILS ABOUT THE AUTISTIC PROBLEMS AMONG CHILDREN

Details	Number	Per cent
Age of Identification		
< 1 year	10	8.3
1-2 years	39	32.5
> 2 years	71	59.5
Total	**120**	**100**
Specific Problems *		
Delayed speech	60	50
Hyperactivity	50	41.7
Echolalia	33	27.5
Poor eye contact	55	29.2
Non-responsiveness	35	29.2
Others	11	9.2
Immunization Pattern		
Immunized regularly	118	98.3
Not immunized regularly	2	1.7
Existence of Autism in Previous Generations		
Yes	2	1.7
No	118	98.3
Total	**120**	**100**

* Multiple response.

Trottier et al. (1999) found that children of six months of age who had certain behaviours that tend to distinguish siblings later diagnosed to have autism. The behaviour included, speech problem, infrequent eye contact and reduced social interaction. Autism is normally said to be diagnosed before the age of six and may be diagnosed in infancy in some cases (www.med terms.com).

In this study 59.2 per cent of children were diagnosed with autism above two years, eight per cent of the mothers reported to have identified autism in their children during their first year of life.

During diagnosis, problems like delayed speech (50 %), poor eye contact (45.8 %), hyperactivity (41.7 %) and non-responsiveness (29.2 %) were observed.

About 98.3 per cent of the parents responded that their child was immunized regularly and the rest of 1.7 per cent reported to have avoided MMR vaccine due to the fear of the undesirable effects caused after vaccination.

The cause of autism is linked to the genetics or hereditary factors. But in this study 1.7 per cent of the parents had complaints of the presence of autism in previous generations (like uncle, brother etc,).

5. Morbidity Pattern

Details on morbidity pattern of the autistic children over a period of six months is presented in Table – XX.

TABLE – XX

MORBIDITY PATTERN OVER SIX MONTHS

(Multiple response)

Details	Cold / cough / sore throat		Fever		Vomiting		Diarrhoea	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Individuals affected	84	70	30	25	2	1.7	7	5.8
Frequency of Infections								
1-2	68	56.7	29	24.1	2	1.7	6	5
> 2	16	13.3	1	0.8	-	-	1	0.8
Mode of Treatment								
Nil	6	5	-	-	-	-	3	2.5
Drug	66	55	30	25	-	-	3	2.5
Others	12	10	-	-	2	1.7	1	0.8
Foods Included								
Cereals and pulses	84	70	30	25	2	1.7	7	5.8
Vegetables	42	35	19	15.8	1	1	2	1.7
Meat, egg, fish and milk	4	3.3	4	3.3	-	-	-	-
Fats and oils	79	65.8	11	9.2	-	-	7	5.8
Sugar	-	-	23	19.2	2	1.7	5	4.2
Foods Avoided								
Fruits	84	70	30	25	2	1.7	7	5.8
Vegetables	42	35	11	9.2	1	1.7	5	4.2
Meat, egg, fish and milk	80	66.7	26	21.7	2	1.7	7	5.8
Fats and oils	5	4.2	19	15.8	2	1.7	-	-
Sugar	84	70	7	5.8	-	-	2	

Morbidity pattern of the 120 autisitc children revealed that 85.8 per cent of them were frequency affected by illness like common cold (70 %), fever (25 %), vomiting (17 %) and diarrhea (58 %) in the past six months. The frequency of morbidity was less than twice for 56.7 per cent of children who suffered from cold, cough and sore throat and also for those suffered from fever (24.1 %), vomiting (1.7 per cent(and diarrhea (5 %).

About 55 per cent of the mothers used drugs as a treatment for cold and 24 per cent for fever. Whereas 0.8 per cent of the children who suffered from diarrhea were given home remedies

Details on food inclusion and exclusion during illness revealed that 70 per cent of the children who suffered from some throat or cold included cereals and pulses and also those who suffered from some throat or cold included cereals and pulses and also those who suffered from other illness did not omit the cereals from their diet. Fruits and sugars were avoided from the diet by all the children who were ill. Around four per cent of the total children selected for the study were reported to be free form illness for the past six months.

D. PRENATAL HISTORY OF THE MOTHERS OF AUTISTIC CHILDREN

Data on pregnancy weight gain, type of delivery, complications during pregnancy, age of mothers at conception, age of father, duration of gestation and birth weight of the child are given in Table – XXI.

TABLE – XXI

DETAILS ON CONCEPTION, PREGNANCY AND BIRTH WEIGHT OF THE CHILDREN

Details	Number	Per cent
Weight Gain		
Normal	117	97.5
Underweight / over weight	3	2.5
Total	**120**	**100**
Type of Delivery		
Normal	52	43.3
Caesarian	68	56.7
Total	**120**	**100**
Complications During Pregnancy		
Anaemia	2	1.7
Hypoxia	2	1.7
Stress	7	5.8
Loss of amniotic fluid	16	13.3
Others	93	77.5
Age of Mother at Conception		
< 25 years	66	55
25-30 years	52	43.3
> 30 years	2	1.7
Total	**120**	**100**

Table continued..

Details	Number	Per cent
Age of Father		
30 years	56	46.7
30-35 years	61	50.8
> 35 years	3	2.5
Total	**120**	**100**
Duration of Gestation		
Full term	108	90
Premature	12	10
Total	**120**	**100**
Birth Weight of the Child		
< 2.5 kg	2	1.7
2.5-3.5 kg	105	87.5
> 3.5 kg	13	10.8
Total	**120**	**100**

It was observed that 97.5 per cent of mothers of autistic children had normal weight gain during pregnancy. Hence there is no relationship between pregnancy weight gain and autism. Around 56.7 per cent of the mothers had caesarian delivery. Mothers reported complications like loss of amniotic fluid (13.3%), stress (5.8 %), anaemia (1.7 %) and hypoxia (1.7 %). Rest of the mothers (77.5 %) faced complications like gastrointestinal problems and use of foreceps during delivery.

Similar study led by Emma (2004) stated that women who have problems during pregnancy and labour are more likely to have children who develop autism. Complications included threatened abortion, induced labour, epidural caudal and anaesthesia and emergency caesarian.

It is notable that in the present study also more than 50 per cent of the mothers underwent caesarian delivery.

Details on consignous marriage, vaccination during pregnancy and presence of Rh incompatibility among the parents of autistic children are shown in Table – XXII.

TABLE – XXII

DETAILS ON CONSIGNOUS MARRIAGE, VACCINATION DURING PREGNANCY AND PRESENCE OF Rh INCOMPATIBILITY

Detail	Number	Per cent
Consaignous Marriage		
Yes	16	13.3
No	104	86.7
Total	**120**	**100**
Vaccination During Pregnancy		
Yes	80	66.7
No	40	33.3
Total	**120**	**100**
Rh incompatibility		
Presence	8	6.7
a. Received Rh gams shots	(5)	(62.5)
b. Not received Rh gams shots	(13)	(37.5)
Absence	112	93.3
Total	**120**	**100**

The above Table – XXII shows that 86.7 per cent of the parents were conjugally married and 13.3 per cent were consignously married. It is observed by researchers that consignous marriage between first cousins increases the prevalence of neurological birth defects by about 100 per cent (www.reuters.com).

Around 66. 7 per cent of the mothers received vaccination during pregnancy and others did not. Out of 120 mothers, 6.7 per cent had Rh incompatibility in which 62.5 per cent had received Rh gam shots and 37.5 per cent did not receive.

E. IMPACT OF NUTRITION INTERVENSIONS AND EDUCATION

The impact of nutrition interventions and education is presented under the following headings:

a. Changes in the awareness among parents of autistic children on 'diet and autism
b. Changes in the mean food and nutrient intake
c. Changes in eating habits and activity levels
d. Changes in the symptoms of autism
e. Changes in the serum immunoglobulin and blood haemoglobin levels

a. Changes in the Awareness among Parents of Autistic Children on 'Diet and Autism'

1. Knowledge of mothers on autism

Knowledge on recommended diet modification and causes for autism is given in Table – XXIII.

TABLE – XXIII

KNOWLEDGE ON RECOMMENDED DIET MODIFICATION AND CAUSES FOR AUTISM

Detail	Number	Per cent
Recommended Diet Modification		
Normal diet	51	42.5
Balanced diet	10	8.3
Elimination diet	26	21.7
No idea	33	27.5
Total	**120**	**100**
Causes		
Complications during pregnancy	7	5.8
Genetic factors	1	0.8
Environmental factors	2	1.7
Others	5	4.2
No idea	105	87.5
Total	**120**	**100**

Table XXIII reveals that 42.5 per cent of the mothers of autistic children followed normal diet for their children, 21.7 per cent believed that elimination diet is best suited for a child with autism while 27.5 per cent of the mothers had no idea on diet modification.

Efforts to find out the causes of ASD have led to many studies looking at a possible toxic environment, toxic food, immune system problems, oxidative stress and emotional stress as important factor (WHO, 2006). In this study 5.8 per cent of the parents believed that autism was caused due to complications during pregnancy. About 1.7 per cent and 0.8 per cent of the parents considered the environmental and

genetic factors respectively and 87.5 per cent of the parents had no awareness about the cause of autism.

2. Changes in the Awareness

Changes in the awareness among the parents of selected autistic children on 'diet and autism' is given in Table – XXIV.

TABLE – XXIV

CHANGES IN THE AWARENESS AMONG PARENTS ON DIET AND AUTISM

(N = 22)

Score	Before			After			't' value
	No	Mean	S.D	No	Mean	S.D	
1-5	16	4.77	± 1.19	0	8.91	± 0.92	15.117**
6-10	6			22			

** - Significant at one per cent level.

From the Table – XXIV it is evident that the mean awareness scores obtained by the parents of autistic children before education was 4.77 out of 10 and the mean score increased to 8.91 after education. Thus, it can be revealed that nutrition education through interactive sessions and distribution of literature in the form of a booklet had a positive impact on the nutritional knowledge of parent of selected autistic children.

b. Changes in the Mean Food and Nutrient Intake

Changes in mean food and nutrient intake of the selected autistic children on elimination diet after nutrition intervention and education are given in Tables – XXV and XXVI.

TABLE – XXV

CHANGES IN THE MEAN FOOD INTAKE

Foods	Allowance g / day (ICMR, 2004)	Nutrition education			
		Before		After	
		Actual intake	% Deficit	Actual intake	% Deficit
Cereals	200	78	-61	89	-55.5
Pulses	45	11	-75.6	26	- 42.2
Green leafy vegetables	67	0	-100	1	-98.5
Others vegetables	67	6	-91	9	-86.6
Roots and tubers	83	27	-67.5	13	-84.3
Fruits	100	24	-76	13	-87
Milk	500	273	-45.4	147	-70.6
Fats and oils	23	1	-95.7	0	-100
Sugar and jaggery	28	11	-60.7	11	-60.7

Table – XXV clearly shows that the mean food intake was deficient when compared to ICMR (2005) values even after nutrition education. The changes were examined among five children with autism who were under elimination diet. Though there was a deficit in food intake, the deficit appeared to be reduced for certain foods after nutrition education. Cereal intake increased by 5.5 per cent by replacing wheat by ragi. The intake of pulse was 75.6 per cent deficit before education which was reduced by 33.4 per cent after education. The increase in intake was also observed in green leafy vegetables and other vegetables, the percentage deficit increased in the case of fruits, milk and fats as the elimination diet excludes the consumption of these food items from the diet of the autistic children, as these are said to increase the autistic characters. Milk was not eliminitated completely because of the children's

likes for the milk. Hence its amount had been reduced to half of the quantity and consumed.

TABLE – XXVI

CHANGES IN MEAN NUTRIENT INTAKE

Nutrients	RDA (ICMR, 2004)	Nutrition education			
		Before		After	
		Mean intake	% Deficit	Mean intake	% Deficit
Energy (k cal)	1627	602.08	-62.99	867.67	-46.67
Protein (g)	31	19.78	-36.19	23.28	-24.9
Fat (g)	25	15.8	-36.8	16.2	-35.2
Iron (mg)	19	8.78	-53.78	9.18	-51.6
Calcium (mg)	400	214	-46.5	192.8	-51.8
β-carotene (μ g)	2000	322.47	-83.87	458.7	-77.06
Thiamine (mg)	0.8	0.59	-26.25	0.78	-2.5
Ribofalvin (mg)	1	0.72	-28	0.82	-18
Vitamin c (mg)	40	18.18	-54.55	18.02	-54.95

Table – XXVI depicts that the intake of all nutrients showed an improved picture after imparting nutrition education but still showed a deficit for all the nutrients when compared to RDA. The percentage deficit decreased for, energy (62.9% to 46.6 %), protein (36.1 % to 24.9 %), fat (36.8 % to 35.2 %), iron (53.7 % to 51.6 %), β carotene (83.8%to 77 %), thiamine (26.2 % to 2.5 %) and riboflavin (28 % to 18 %). The intake of vitamin c showed no improvement but percentage deficit increased for calcium by 5.3 per cent due to decreased intake of milk by the children. This indicates that the gross deficit of nutrients was decreased due to the increase in food intake after nutrition intervention and education.

c. Changes in Eating Habits and Activity Levels

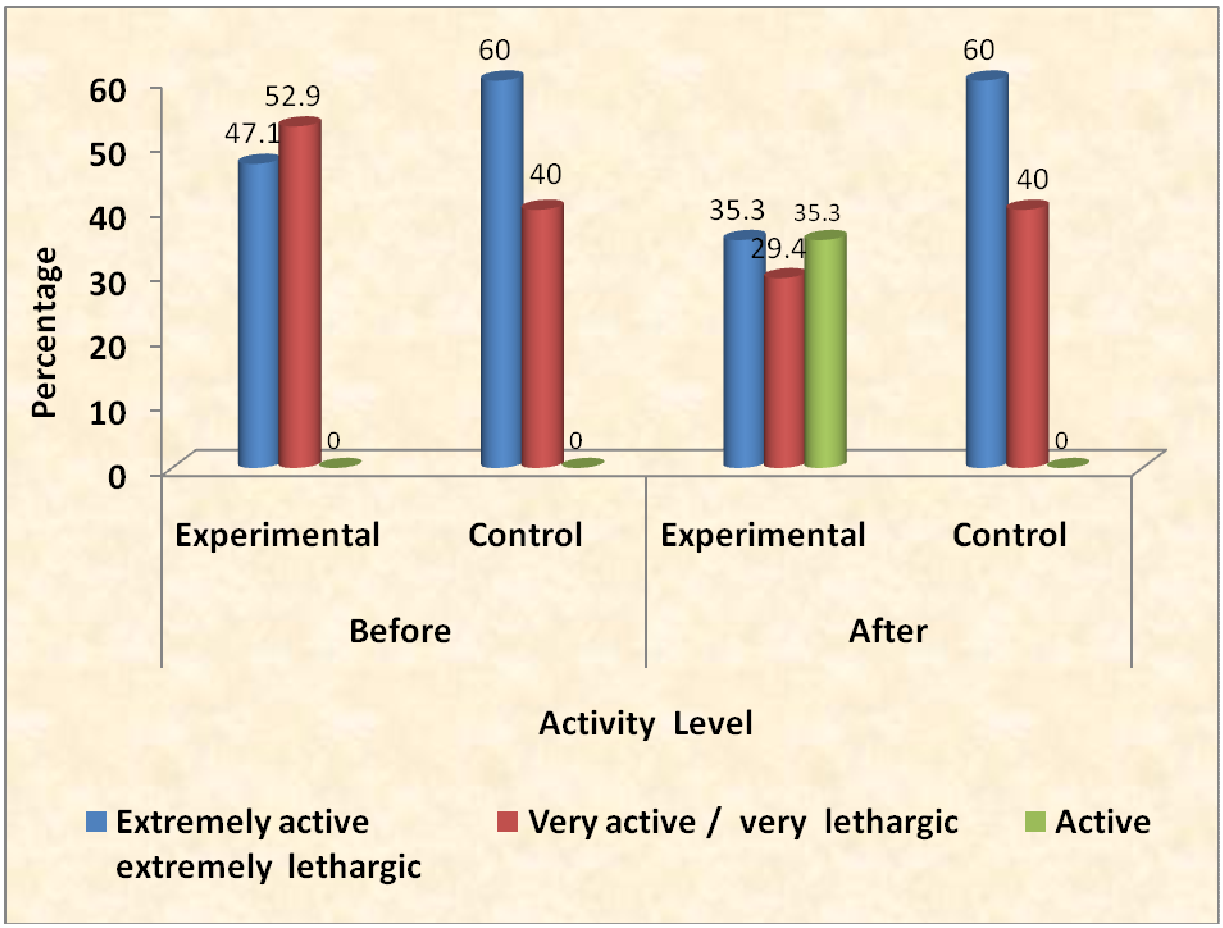
The changes in the activity level and eating habits among the autistic children after nutrition education, supplementation of flax seed and introduction of elimination diet is depicted in Table – XXVII and figure 2 and 3.

TABLE – XXVII

CHANGES IN THE ACTIVITY LEVEL AND EATING HABITS IN AUTISTIC CHILDREN

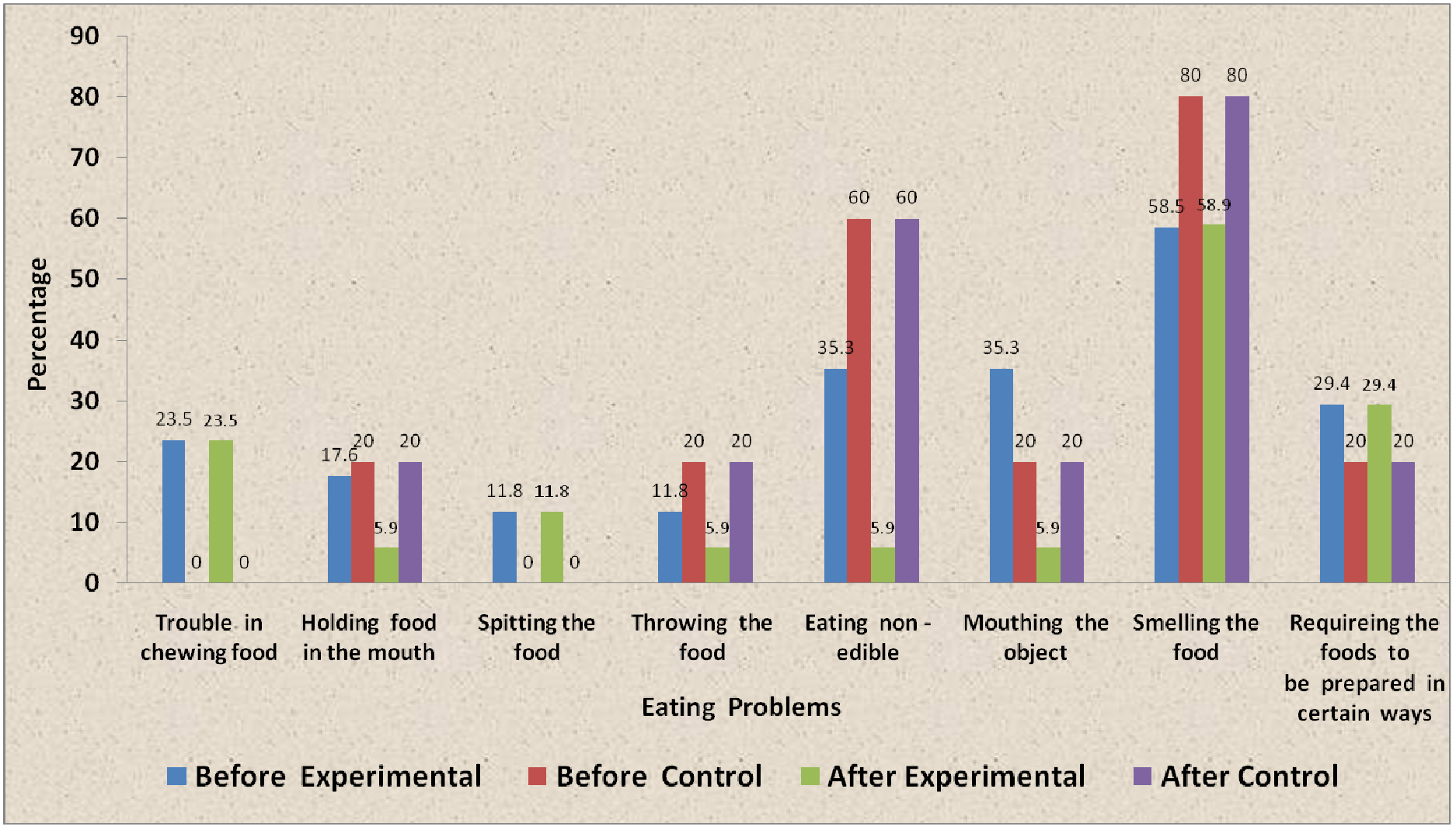
Parameters	Before				After			
	Experimental (17)		Control (5)		Experimental (17)		Control (5)	
	No	%	No	%	No	%	No	%
Activity Level								
Extremely active / extremely lethargic	8	47.1	3	60	6	35.3	3	60
Very active / very lethargic	9	52.9	2	40	5	29.4	2	40
Active	-	-	-	-	6	35.3	-	-
Eating Problems *								
Trouble in chewing food	4	23.5	-	-	4	23.5	-	-
Holding food in the mouth	3	17.6	1	20	1	5.9	1	20
Spitting the food	2	11.8	-	-	2	11.8	-	-
Throwing the food	2	11.8	1	20	1	5.9	1	20
Eating non-edible	6	35.3	3	60	1	5.9	3	60
Mouthing the object	6	35.3	1	20	1	5.9	1	20
Smelling the food	10	58.5	4	80	10	58.9	4	80
Requiring the foods to be prepared in certain ways	5	29.4	1	20	5	29.4	1	20

* - Multiple response.



Change in the activity level

Figure. 2



Change in the eating habits
Figure . 3

From the above Table – XXVI, it is seen that there was a slight improvement in the activity level and eating habits of the autistic children. Around 47.1 per cent of children in experimental group were extremely active before nutrition intervention and education and this reduced to 35.3 per cent. Children's current activity level got reduced by 23.5 per cent after education and diet therapy.

Among eating behaviour patterns, problems like holding food in the mouth (17.6 to 5.9 %) throwing the food (11.8 to 5.9 %), eating non-edibles and mouthing the object (35.3 to 5.9 %) were party solved. But trouble in chewing the food, spitting the food and requiring the food to be prepared in certain ways did not show any alterations even after education and diet therapy. No changes were observed in the control group. This indicates that supplementation of flax seed powder and elimination diet has a positive effect on behaviour problems in autistic children.

d. Changes in the Symptoms of Autism

The changes in the symptoms of autism in the children after nutrition education, supplementation of flax seed and introduction of elimination diet is given in Table - XXVIII.

TABLE – XXVIII

CHANGES IN THE SYMPTOMS OF AUTISM

(Multiple response)

Parameters	Before		After	
	Experimental (N=17)	Control (N=5)	Experimental (N=17)	Control (N=5)
Repeated body movements	5	2	4	2
Spinning objects	3	1	2	1
Toe walking	4	3	4	3
Echolalia	4	3	4	3
No eye contact	9	2	3	2

Table continued..

Parameters	Before		After	
	Experimental (N=17)	Control (N=5)	Experimental (N=17)	Control (N=5)
Rubs surface mouths or licks object	6	2	1	2
Temper tantrums	8	-	3	-
Short attention span	9	2	4	2
Aggression to self or others	6	1	3	1

Partial improvement wass seen among autistic children belonging to experimental group whose mothers were given nutrition education and who underwent diet therapy. Repeated body movements were seen among five children before education and it reduced to four. Spinning objects were observed among three children and it reduced to two after education. Eye contact improved in three children and five stopped rubbing surface. Tantrums were minimally reduced in five children. While improved attention span was seen in five children, three children had reduced aggressive behaviour. No changes were observed in control group. Problems like toe walking and echolalia did not show any improvement in both the groups.

e. Changes in the Serum Immunoglobulin and Blood Haemoglobin Levels

The changes in serum immunoglobin G levels and blood haemoglobin levels in selected autistic children after flax seed supplementation are given in Table – XXIX and figure 4 and 5.

TABLE – XXIX

CHANGES IN SERUM IMMUNOGLOBULIN G AND BLOOD HAEMOGLOBIN LEVELS

Parameters	Before	After	Mean Difference	't' value
	Mean ± S.D	Mean ± S.D		
Serum Immunoglobulin G (mg/dl)				
Group E1	44.52 ± 83.07	507 ± 77.99	63.26	8.93*
Group E2	367 ± 91.38	410.4 ± 35.80	42.56	3.62 NS
Group E3	373.2 ± 69.33	512.9 ± 42.74	139.76	12.24**
Group E4	381.9 ± 74.51	503.0 ± 70.09	121.06	7.58*
Mean ± S.D	391.89 ± 111.88	483.56 ± 118.07	91.67	5.03**
Control group	436.7 ± 57.19	434.3 ± 58.2	2.4	0.98 NS
Blood Haemoglobin (g/dl)				
Group E1	10.03 ± 67.5	11.36 ± 1.12	1.33	7.18*
Group E2	10 ± 2.19	11.3 ± 0.89	1.23	1.2 NS
Group E3	8.1 ± 0.93	10.2 ± 0.75	2.12	15.9**
Group E4	7.73 ± 0.36	9.4 ± 0.86	1.66	1.4 NS
Mean ± S.D	8.15 ± 1.94	10.5 ± 1.15	2.35	4.59**
Control group	5 ± 0.81	5.5 ± 0.61	0.54	2.6 NS

* - Significance at 5 % level; ** - Significance at 1 % level; NS – Not Significant

Serum Immunoglobulin G Level

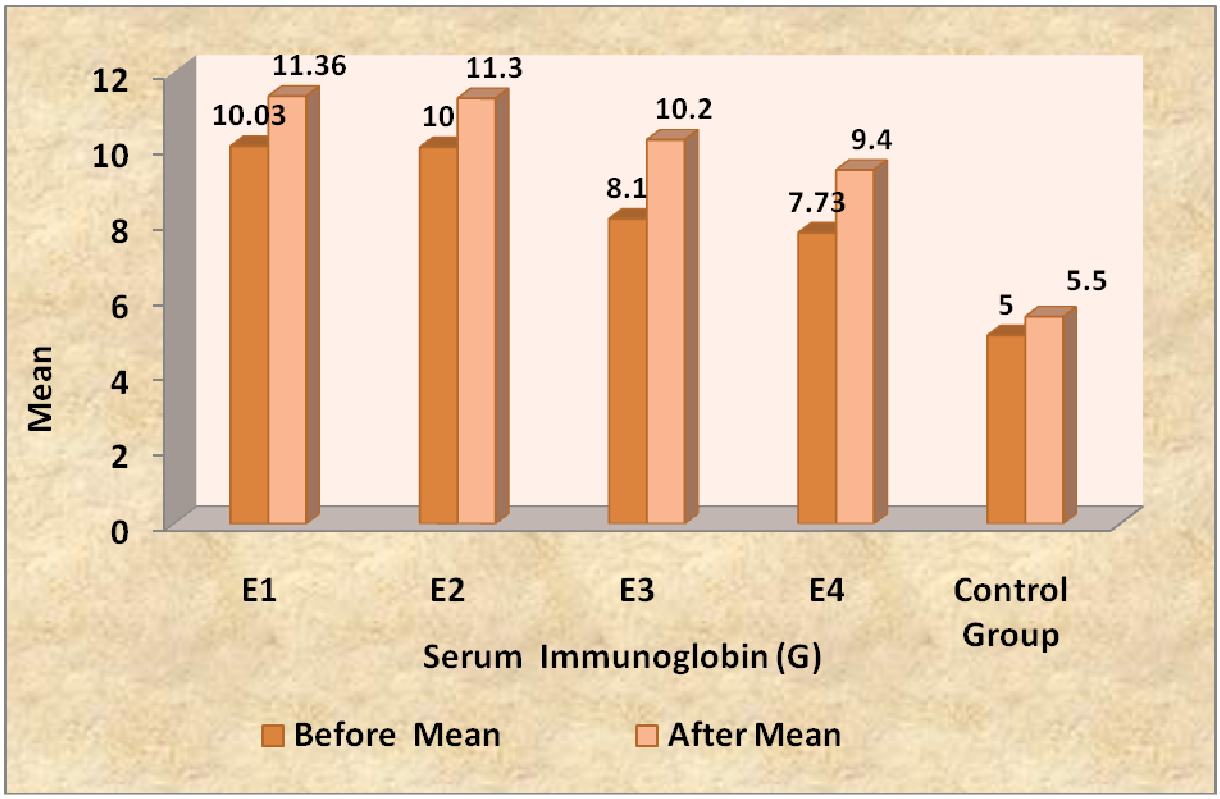
From Table – XXIX it is observed that there was an increase in the serum immunoglobulin G levels in the experimental group after nutrition intervention and education. Among the experimental groups, E3 had the higher mean difference showing that 15 g of flax seed powder supplied to the autistic children significantly

improved their immunity levels ($p<0.01$) while the others showed significance at five per cent level (E1, E4) and E2 group showed no significance at all. The overall mean serum immunoglobin G values increased after supplementation of flax seed and the overall‘t’ value showed significance at one per cent level. Control group showed no progress in serum immunoglobin G levels.

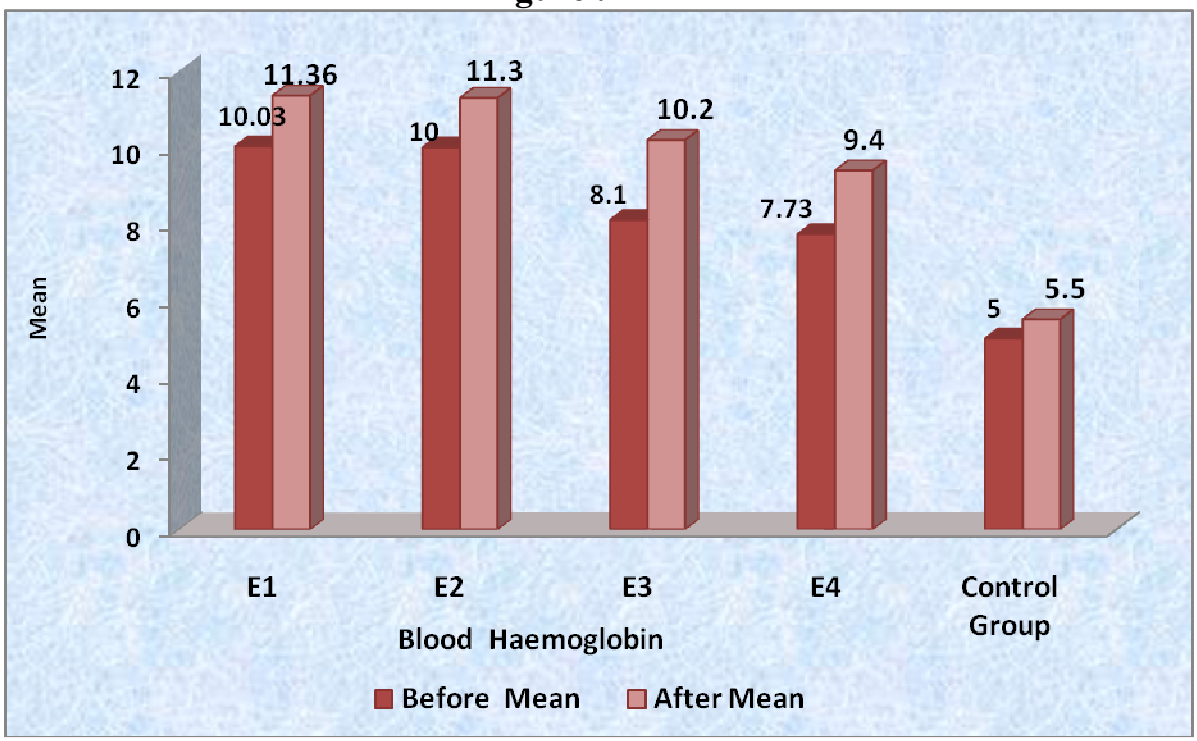
Blood Haemoglobin Levels

Blood haemoglobin levels were examined for the experimental group. Children who had consumed flax seed powder. Table – XXIX proves that there was a slight increase in haemoglobin levels in blood of autistic children. The children in group E3 showed better improvement than the other groups. The mean increment in blood haemoglobin level of group E3 was 2.12g/dl and it was significant at one per cent level. The mean blood haemoglobin levels did not seem to change in the control group. This indicates that flax seed powder had a positive impact on autistic children by improving the immunity levels and iron nutriture in their body.

From the above results and discussions it can be concluded that deviations from the normal behaviour has an impact on the nutritional status of the children with autism. Problems in the eating habits and frequent illness affect the food intake among such children. Nutrition education has a definite role to play in creating an awareness among the parents. The effect of supplementation of flax seeds and introduction of elimination diet has been brought under the spot light and has shown to increase the immunoglobin G levels and has resulted in positive impact on the eating habits of autistic children.



Change in the serum immunoglobin (G) levels
Figure . 4



Change in blood haemoglobin levels
Figure . 5

V. SUMMARY AND CONCLUSION

The present investigation entitled "Effect of introduction of elimination diet and supplementation of flax seed in autistic children (2-7years)", aimed at observing the feeding problems and eating behaviour among autistic children and the beneficial effect of nutrition education, flax seed supplementation and elimination diet on these children. For this purpose, a total of 120 children in the age group of 2-7 years were selected from 10 special schools in both Coimbatore and Chennai cities. An interview schedule was adopted to collect relevant information regarding demographic status dietary habits, nutritional status of autistic children, and prenatal history of the mothers of autistic children. Height and weight were determined and clinical assessment was undertaken for all the 120 children. Fifteen autistic children were randomly divided into five groups of three children each. Four groups of experimental (E1, E2, E3 and E4) children received 5g, 10g, 15g and 20g of flax seed powder per day respectively for two and a half months. Children in control group C did not receive any supplementation. The parameters used to evaluate the impact of flax seed supplementation was serum immunoglobin G level and blood haemoglobin level.

Similarly two groups of five autistic children each were selected for introducing elimination diet. The experimental group children were advised to follow elimination diet for three months while the control group children followed the normal diet. The parameters used for evaluation of the impact were diet recall, activity levels, eating problems and symptoms of autism.

All the mothers of 22 autistic children were selected for education on 'diet and autism', through a specifically developed booklet. The booklets was composed of information on autism, causes, treatments, elimination diet and recipes incorporated with flax seed powder. The salient findings of the study were:

I. DEMOGRAPHIC PROFILE

- Out of 120 children selected for the study, 97 were males and 23 were female. Therefore boys were at higher risk than girls.
- About 56.7 per cent of children were between the age of 1-5 years.

- Majority of the children (91.6%) were Hindus and belonged to nuclear family (87.5%).

- Among the family members, 316 were male and 229 were female. About 45.1 per cent were between 31-40 years and 24.4 per cent were between 0-10 years of age.

- Regarding educational status, 47.6 per cent of the female had completed their higher education whereas 24.4 per cent of male did their graduation.

- Only four males and six females were found to be illiterate and one female did not join schooling.

- Occupational details of the head of the family revealed that 35.8 per cent of the fathers were doing business and only 15 per cent were employed in government jobs.

- About 74.2 per cent of the children belonged to high income group indicating that the prevalence of autism was seen more in high income group.

- About 77.5 per cent of the families spent around 25-50 per cent of their total income on food. Majority of the families allotted less than 10 per cent of the income for clothing (90%), shelter (68.3%) and education (18.3%). Less than 5 per cent of the income was spent on medicine (81.7%), fuel (53.3%), transport (61.7%), debt (92.5%), entertainment (83.3%) and other miscellaneous expenses (30.8%). More than five per cent of the income was saved by 92.5 per cent of the families.

II. DIETARY HABITS OF THE AUTISTIC CHILDREN

- All the children regularly consumed food items like rice, milk, sugar, coffee and oils. Wheat was consumed only once a week by 28.3 per cent of the children. Pulses like black gram dhal were consumed daily by 85 per cent of children. Among vegetables 99 per cent of children consumed other vegetables and 93 per cent liked to take roots and tubers daily. Fruits were consumed daily by majority of the children (59.2%). Fleshy foods were

- and pulses formed the major weaning foods.

- Mothers of autistic children mainly considered commercial foods as special food for consumed only once in a week. Among baked food, biscuits were most preferred and consumed daily by 85.8 per cent of children.

- Majority of the mothers (50.8%) breast fed their children for more than 12 months and 90 per cent of mothers had started the weaning between 6-12 months. Cereals their children and 70 per cent of mothers did not provide any special food. Snacking between the meals was found among 80 per cent of the children and 70 per cent did not skip the meals.

- Timely feeding was seen in 85 per cent of the children and 65 per cent of the children had good appetite.

- Factors like taste, texture, temperature, smell and appearance had influence on the child's selectivity of food. Most of the children (24.2%) were affected by the smell of the food and 78 children were not affected by any of these factors.

- Health problems had a direct influence on the child's eating habits. Problems like ear infection (2.5%), medication (3.3%), asthma (8.3%), seizure (5.8%), hospitalization (1.7%), dental caries (6.7%) and food allergy (22.5%) were common among autistic children. Around 37.5 per cent of the children had the habit of smelling the object or food and 36.7 per cent were found to spit the food when not liked. Multiple feeding problems were found to affect the nutritional status of the children.

- The current activity level of autism children were found to range from extremely active to lethargic. High activity level was seen in 31.3 per cent of the children and only 1.7 per cent of the children were found to be lethargic.

III. NUTRITIONAL STATUS OF THE AUTISTIC CHILDREN

- The mean height and weight of both boys and girls were found to be lower than the ICMR and NCHS standards. Compared to girls, boys were observed to be taller. Signs and symptoms of nutritional deficiencies were predominant

features in most of the children with autism. Clinical signs like poor musculature (35.8%), tenderness of calf (20.8%), dental caries (19.2%) and deficient subcutaneous fat (11.7%) were observed among most of the children.

- Autism was diagnosed at the age of above two years in 59.2 per cent of the children. Specific problems like delay in speech (50%), poor eye contact (45.8%), non responsiveness (29.2%) and hyperactivity (41.7%) were found at the age of identification. Most of the autistic children (98.3%) were regularly immunized and others avoided certain vaccines like MMR due to its toxic effect. Existence of autism in previous generation was noted in only two families.

- Out of 120 children studied 85.8 per cent were affected by various infections like common cold (84%), fever (25%), vomiting (1.7%) and diarrhea (5.8%). Majority were infected only once or twice. Drugs were used for the treatment of infection. Foods like cereals, pulses and oils were included and fruits and certain vegetable like potatoes and sugar were avoided during illness.

IV. PRENATAL HISTORY OF THE MOTHERS OF AUTISTIC CHILDREN

- Mothers of 117 autistic children reported to have normal weight gain during pregnancy. Caesarian delivery was undergone by 56.7 per cent of the mothers, which might have had a direct effect on the mental development of the children.

- Complication during pregnancy had a direct relation with autism. In the present study, problems like anemia (1.7%), hypoxia (1.7%), stress (5.8%) and loss of amniotic fluid (13.3%) were observed among the mothers of the autistic children.

- Majority of the fathers (50.8%) were between the age of 30-35 years and mothers (55%) below the age of 25 years during conception.

- The period of gestation for 90 per cent of the mothers was full term. The birth weight of 105 autistic children was normal. The birth weight of the children did not seem to have any connection with autism.

- Among 120 mothers 13.3 per cent had got married to their relatives. Genetic factors play an important role in autism.

- Regarding immunization and Rh incompatibility, 66.7 per cent of the mothers had received vaccines during pregnancy and only 6.7 per cent of the parents had Rh incompatibility.

V. IMPACT OF NUTRITION INTERVENSION AND EDUCATION

- The mean initial knowledge score for the awareness of mothers on autism was 4.77. The mean score after nutrition education was found out to be 8.91 and it improved by 4.14. The t-value was found to be 15.117 that indicated significance at one per cent level.

- Mean food intake of children was found to be deficient when compared to ICMR recommendation even after nutrition education. However the intake of certain foods appeared to be reduced after nutrition education. It was due to elimination of wheat, fruits, milk and certain vegetables from the diet of the autistic children.

- The intake of all nutrients showed an improved picture after imparting nutrition education, but still showed a deficit for all nutrients when compared to RDA of ICMR. The percentage deficit decreased for all the nutrients due to the increase in food intake after nutrition education. For certain nutrients like calcium the deficit per cent was increased due to reduction of milk to half the quantity.

- Changes in the activity level and eating habits were observed in autistic children after introducing elimination diet and nutrition education. Children with extreme activity or lethargic (47.1%) became very active (40%) or active (35.3%) after nutrition intervention. Eating problems like holding food in the mouth (17.6 to 5.9%), throwing the food (11.8 to 5.9%), eating non edible

(35.3 to 5.9%) and mouthing the objects (35.3 to 5.9%) were observed to decrease.

- Flax seed supplementation brought about a difference in serum immunoglobulin G levels of the autism children. The experimental group E3 (supplied with 15g of flax seed per day) was found to show a greater difference in their immunoglobulin G levels. The mean initial serum immunoglobulin G level for the four experimental groups put together was 391.89 mg/dl and after supplementation it increased to 483.56 mg/dl.

- Before nutrition education and supplementation one child had sever anemia, 5 had moderate anemia and 5 had mild anemia. The number had decreased after diet therapy and education. Mild anemia was found among 7 children and 3 had moderate anemia. The rest were found to be non anemic.

From the above results, it is clear that nutrition interventions along with education provided to the mothers of autistic children brought out significant improvements in health status, dietary practices, biochemical and clinical profile of the children. It had also helped to reduce certain behavioral problems in the children. There is now evidence that good nutrition during infancy and early diagnosis of autism could correct psychomotor underdevelopment in the future.

Flax seed powder being incorporated and supplemented for a period of 75 days in the diet of autistic children has proven to be an immunostimulant by validating the serum immunoglobin G levels, blood haemoglobin levels and improvements in behaviour problems. The elimination diet has also shown to improve the activity levels and reducing the eating problems among children. Hence, nutrition education through mass medias can help the young parents to identify autism, its cause and provide multiple treatments (behavioural, nutrition and drug therapy) at early stage of the child's life. Moreover awareness can be created among pregnant women and young girls about the complications of pregnancy and its consequences.

To conclude, flax seed and elimination diet had proved to influence the behaviour pattern of children with autism.

LIMITATIONS OF THE STUDY

The effectiveness of the diet therapies like gluten-free and casein-free diet can be made more evident when quantitatively analyzed through urinary peptide levels. Impact of flax seed supplementation could be quantified through the changes in serum fatty acid levels. Since these tests are not carried out on regular basis in the laboratories at feasible cost, the impact of such diet and supplement were measured in qualitative scales.

The other problems faced in this study were the inability of the parents to completely eliminate milk, sugars, fruits, biscuits and certain outside food from their child's diet as they were addicted to these foods. Hence, the elimination was carried out only at 50 per cent level because immediate withdrawal of these foods was not possible. Also the investigator had come across those children who keep changing the treatments at every 6 months as the parents expect their children to show improvement within 4 or 5 months which is not possible, as such children require long term treatment.

Nutrition interventions coupled with other treatments on a long term basis will go a long way in improving health status, reducing behavioural problems and also to improve the daily living activities of the children.

RECOMMENDATIONS FOR FUTURE STUDIES

1. Studies on the effectiveness of elimination diet using urinary peptide test as a parameter for evaluation.
2. Impact of nutrition interventions like specific carbohydrate diet, body ecology diet and multi-vitamin therapy carried out on long term basis.
3. Investigation about the food allergens that causes autism.
4. Developing casein free milk and milk products.
5. Testing the acceptability of flax seed oil and its effectiveness in autistic children.

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ANNEXURE- 1

A QUESTIONNAIRE TO ELICIT THE INFORMATION REGARDING THE NUTRITIONAL, HEALTH PROFILE AND EATING BEHAVIOUR OF AUTISTIC CHILDREN

Date:

Name of the investigator :

Name of the interviewee :

I. Background information

1. Name :
2. Age :
3. Sex :
4. Address : Residential Phone No. School / Institution Phone No.
5. Religion :
6. Type of family: Joint ☐ Nuclear ☐
7. Family Background

S.No.	Name of the family members	Relationship with the head of the household	Age	Sex	Education	Marital status	Occupation	Monthly income

8. Monthly expenditure pattern :

Expenditure	Amount (Rs.)	Percentage of income
Food Clothing		

Shelter Education Medicine Fuel Transport Debt Entertainment Savings Others		

II Food pattern and dietary habits

9. Food habits : Vegetarian/Non-vegetarian/Ova-vegetaria

10. Do you have food beliefs ?

Yes ☐ No ☐

Food fads	Name of the food stuff	Reason for avoiding
Hot foods Cold foods Gas producing foods Bile producing foods Foods causing skin diseases Foods causing colic pain		

11. 3 days dietary recall

Meal	Early morning	Breakfast	Mid-morning	Lunch	Tea	Dinner	Bed-time
1st day 2nd day 3rd day							

12. Do you provide any special foods to the child?

Yes ☐ No ☐

Give reason …….

13. Does the child snack in between the meals?

Yes ☐ No ☐

14. Does the child skip the meals?

Yes ☐ No ☐

III Eating habits

15. What is the child's current activity level :

a) Extremely active

b) Very active

c) Moderately active

d) Active

e) Quiet

f) Lethargic

16. How long was the child breast fed?

17. What was the age of weaning and introduction of supplementary foods?

Age :

Foods given :

Reason :

18. Which type of feeding did you follow?

Demand feeding ☐

Timely feeding ☐

19. How is the child's appetite :

Poor for all foods ☐

Good for those foods she / he likes ☐

Good for most foods ☐

20. Is your child a picky eater?

Yes ☐ No ☐

Comment ……

21. If yes, then what do you think are the factors influencing your child's selectivity?

a) Taste

b) Texture

c) Temperature

d) Smell

e) Appearance

22. Do you think, there is a relationship between your child's eating and his / her behaviour?

Yes ☐ No ☐

Comment ……

23. Has your child's eating is affect by any health problem?

Yes ☐ No ☐

If yes, describe the following

Ear infection :

Having to take medication :

Asthma :

Seizures :

Hospitalization :

Others (specify) :

24. Does your child have food allergies or food intolerance?

Yes ☐ No ☐

Describe ……

25. Does your child has / had any of the following habits / problems?

Trouble chewing food ☐

Holding food in mouth / cheeks ☐

Spitting foods ☐

Dumping / throwing foods ☐

Eating non-edibles ☐

Mouthing objects ☐

Smelling foods ☐

Eating foods only in certain places ☐

Unwilling to try new foods ☐

Requiring foods to be prepared in certain ways ☐

Others (mention) ☐

26. Describe the eating frequency:

1 – Eaten daily

2 – Eaten 4 – 6 time / week

3 – Eaten 3 – 4 times / week

4 – Eaten once in a week

5 – Never eaten

S.No.	Food item	Eating frequency				
		1	2	3	4	5
1.	**Cereals**					
	Rice					
	Wheat					
	Ragi					
	Cholam					
2.	**Pulses**					
	Black gram dhal					
	Green gram dhal					
	Bengal gram dhal					
	Horse gram dhal					
	Red gram dhal					
	Dried peas					
3.	**Green leafy vegetables**					
	Roots and tubers					
	Other vegetables					
4.	**Butter fats and oils**					
5.	**Fruits**					
6.	**Fleshy foods**					
	Egg					

	Mutton					
	Chicken					
	Fish					
	Others					
7.	**Milk**					
	Milk to drink					
	Milk in coffee					
	Butter milk					
	Curd					
8.	**Sugar and jaggery**					
9.	**Beverages**					
	Tea					
	Coffee					
	Fruit juices					
	Others					
10.	**Baked foods**					
	Cake					
	Biscuits					
	Bread					
	Others					
11.	**Preserved foods**					
	Jams					
	Jellies					
	Others					

27. What do you think is the recommended diet modification for an autistic child?

IV. Morbidity pattern

28. How old was the child when the problem was identified?

29. What were the specific problems in the child?

30. Has the child immunized regularly?

31. Are there any child / members in your family who was / is suffering from autism? If yes give details.

32. Morbidity pattern (past six months)

Disease	Frequency	Mode of treatment	Foods included	Reason	Foods avoided	Reasons
1. Cold 2. Cough 3. Sore throat 4. Fever 5. Vomitting 6. Diarrhoea 7. Stomach ache 8. Jaundice 9. Measles 10. Others						

33. What do you think is the cause for the autism?

V. Prenatal history

34. Was the weight gain normal during pregnancy?

35. What was the type of delivery?

Normal ☐ Caesarian ☐

36. Was there any complication during delivery / pregnancy?

	Yes	No
a. Multiple birth	☐	☐
b. Anaemia	☐	☐
c. Hyper tension	☐	☐
d. Toxemia	☐	☐
e. Rubella	☐	☐

f. Respiratory infection ☐ ☐

g. Gastro intestinal infection ☐ ☐

h. Allergy ☐ ☐

i. Hypoxia ☐ ☐

j. Stress ☐ ☐

37. Age of the mother at conception :

38. Age of father :

39. Duration of gestation

Full term ☐

Premature ☐

40. Birth weight of the child :

41. Is your marriage consaignous?

42. Did you receive any vaccine during pregnancy?

43. Was there Rh incompatibility? Did you receive Rho gams shots?

VI. Nutritional status

A. Anthropometry

a) Height : cm

b) Weight : kg

B. Bio chemical

a) Haemoglobin:

C. Clinical

Healthy and free from any deficiency symptoms

a. Poor musculature

b. Deficient subcutaneous fat

c. Mild anaemia

d. Tenderness of calf

e. Angular stomatitis

f. Bleeding gum

g. Angular conjunctiva

h. Bitot's spot

i. Dental caries

j. Dry / rough skin

k. Discoloured / dry / sparse / brittle hair

D. Family and individual consumption survey weighment method

FOOD CONSUMPTION

Name of the meal	Menu	Weight of the total raw ingredients used by the family (g)	Weight of the total cooked food consumed by the family (g)	Amount of cooked food consumed by the individual (g)	Raw equivalents consumed by the individual (g)
Breakfast Lunch Tea Dinner					

ANNEXURE-5

AN INTERVIEW SCHEDULE TO ASSESS THE AWARENESS AMONG PARENTS OF SELECTED AUTISTIC CHILDREN ON "DIET AND AUTISM"

Name : Mother of :

School :

QUESTIONS : (Tick (✔) the correct ones)

1. Autism is

   A deficiency disease ☐ An infectious disease ☐

   A brain developmental disorder ☐ None ☐

2. Causes for autism is

   Micro –organism ☐ Pollution ☐

   Stress ☐ Genetic factor ☐

3. Treatment for autism is

   Behaviour and nutritional therapy ☐ Surgery ☐

Medication ☐ None ☐

4. Ideal diet for autistic individual is

   High protein diet ☐ Low sodium diet ☐

   Elimination diet ☐ Balanced diet ☐

5. Foods included in gluten free – casein free diet are

   Wheat and milk ☐ Rice and milk ☐

   Rice and wheat ☐ Rice and ragi ☐

6. Omega – 3 fatty acid helps in

   Providing energy ☐ Growth ☐

   Brain development ☐ Improving digestion ☐

7. Foods rich in omega 3 fatty acid are

   Fish and flax seed ☐ Butter and cheese ☐

   Fruits and vegetable ☐ Cereals ☐

8. Flax seed powder can be given to improve

   Vision ☐ Language, skill and immunity ☐

   Blood circulation ☐ Body weight ☐

9. Commercial foods like biscuits, chips, pickles are avoided because

   They are costly ☐ They are ready to eat ☐

   They have preservatives ☐ None ☐

10. Sugar, chocolates, candies are not advised as it causes

    Hyper activeness ☐ Heart problem ☐

    Infections ☐ Deficiency ☐

ANNEXURE-2

AN INTERVIEW SCHEDULE TO ELICIT THE BEHAVIOURAL CHARACTERISTIC OF THE SELECTED AUTISTIC CHILDREN

Name : Age :

School : Sex :

I. ACTIVITY LEVEL

a. Extremely active / Extremely lethargic ☐

b. Very active / Very lethargic ☐

c. Active ☐

II. EATING PROBLEMS

		Yes	No
a.	Trouble chewing food	☐	☐
b.	Holding food in the mouth	☐	☐
c.	Spitting the food	☐	☐
d.	Throwing the food	☐	☐
e	Eating non-edibles	☐	☐
f.	Mouthing the objects	☐	☐
g.	Smelling the food	☐	☐
h.	Eating the foods only in certain places	☐	☐
i.	Unwilling to try new foods	☐	☐
j.	Requiring the foods to be prepared in certain ways	☐	☐

III. SYMPTOMS OF AUTISM

		Yes	No

a.	Repeated body movements (flapping hands etc.)	☐	☐
b.	Spinning objects / self	☐	☐
c.	Toe walking	☐	☐
d.	Echolalia	☐	☐
e	No eye contact	☐	☐
f.	Rubs surface, mouths or licks objects	☐	☐
g.	Temper tantrums	☐	☐
h.	Short attention span	☐	☐
i.	Aggression to self or others	☐	☐

IV. IMMUNOGLOBULIN LEVELS

Serum Immunoglobulin G

ANNEXURE-6

BOOKLET ON "DIET AND AUTISM"