"ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA"

Dissertation submitted in partial fulfilment of university regulations for the award of degree of

M.D. DEGREE EXAMINATION

PAEDIATRICS BRANCH VII

THE TAMILNADU DR. M.G.R. MEDICAL

UNIVERSITY, CHENNAI,

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INSTITUTE OF CHILD HEALTH &

HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

CHENNAI-600008

MAY 2018

CERTIFICATE

This is to certify that the dissertation entitled **"ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA"** submitted by **DR.K.SELVARAJU** 2015-2018 session at Madras Medical College to the faculty of Paediatrics, The Tamilnadu Dr. M.G.R Medical University, Chennai in partial fulfilment of the university rules and regulations for award of **M.D., Degree in Paediatrics** (BRANCH VII) is a bonafide research work carried out by him under our direct supervision and guidance.

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DECLARATION

This dissertation entitled **"ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA"** is a bonafide work done by **Dr.K.SELVARAJU** at Institute of Child Health, Madras Medical College, Chennai during the academic year 2015-2018 under the guidance of **Prof. DR.S.LAKSHMI, MD.,DCH,** Professor of Paediatrics, Institute of Child Health, Chennai-600008. This dissertation submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai towards partial fulfilment of the rules and regulations for the award of **M.D Degree in Paediatrics**, (Branch VII).

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DECLARATION

I, **Dr.K.SELVARAJU**, solemnly declare that this dissertation entitled **"ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA"** was done by me under the guidance and supervision of **Prof. DR.S.LAKSHMI, MD., DCH.** This dissertation is submitted to The Tamilnadu Dr.M.G.R Medical University, Chennai in partial fulfilment of the rules and regulations for the award of **M.D Degree in Paediatrics (Branch VII).**

Place: Chennai **Dr.K.SELVARAJU**

Date:

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I thank all the parents and children who have ungrudgingly lent themselves to undergo this study without whom, this study would not have seen the light of the day.

INSTITUTIONAL ETHICS COMMITTEE
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CERTIFICATE OF APPROVAL

To
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Dear Dr.Selvaraju.K.,

The Institutional Ethics Committee has considered your request and approved your study titled **"ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES – A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA "** - **NO.23022017**

The following members of Ethics Committee were present in the meeting hold on **07.02.2017** conducted at Madras Medical College, Chennai 3

1.Dr.C.Rajendran, MD.,	:Chairperson
2.Dr.M.K.Muralidharan,MS.,M.Ch.,Dean, MMC,Ch-3	:Deputy Chairperson
3.Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
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9.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person
10.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
11.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary – Ethics Committee

MEMBER SECRETARY
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CERTIFICATE –II

This is to certify that this dissertation work titled **"ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA."** of the candidate **DR.K.SELVARAJU** with registration Number : **201517013** for the award of **M.D PAEDIATRICS** in the branch of **VII**. I personally verified the urkund .com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **1 percentage** of plagiarism in the dissertation.

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ABBREVIATIONS

AGE-Acute Gastro Enteritis

ASOM-Acute Suppurative Otitis Media

ATP-Adenosine Tri Phosphate

ATPase-Adenosine Tri Phosphatase

ADH-Anti Diuretic Hormone

ADHD-Attention Deficit Hyperactivity Disorder

Ca^{+}-Calcium ions

°C-Degree Celsius

CSF- Cerebro Spinal Fluid

CNS-Central Nervous System

Cu-Copper

cAMP- cyclic Adenosine Mono Phosphate

cGMP- cyclic Guanosine Mono Phosphate

Da-Dalton

DMSO-Di Methyl sulfoxide

ECG-Electro Cardio Graphy

EEG-Electro Encephalogram

EGTA-Ethylene Glycol Tetra Acetic acid

GABA-Gamma Amino Buytric Acid

GFR-Glomerular Filtration Rate

HMG CoA - 3-Hydroxy 3-Methyl Glutaryl CoA

HDL-High Density Lipoprotein

K^+-Potassium ions,

KCN-Potassium Cyanide

LCAT-Lecithin Cholesterol Acyl Transferase

LRI-Lower Respiratory tract Infection

NIH-National Institute of Health

NMDA- N-methyl D-aspartate

Na^+-Sodium ions

PTH-ParaThyroid Hormone

RNA-Ribo Nucleic Acid

URI-Upper Respiratory Infection

CONTENTS

INTRODUCTION

INTRODUCTION

Febrile seizures defined as seizures that occurs between the age of six and sixty months, with a temperature of 38 degree C or higher, that are not the result of central nervous system infection or any metabolic imbalance and that occur in the absence of a history of prior afebrile seizures. (1)

About 30-40 % of children with first episode of febrile seizures will experience recurrences, hence febrile seizure is an important illness to understand and prevent. (2)

The exact pathogenesis is not fully understood but involves several factors like genetic predisposition, changes in the levels of neurotransmitters and some trace elements. Several studies demonstrated that the level of some trace elements play a vital role in causation of seizures. (3)

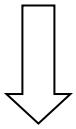
Alterations in the blood levels of sodium (Na^{+}), potassium (K^{+}), calcium (Ca^{+}) and magnesium (Mg^{+}) have been implicated in the pathogenesis for developing seizures. Normal level of these electrolytes is necessary for maintaining central nervous system function. Changes in cell membrane ion gradient can lead to direct and indirect impact on nervous discharges and thus facilitating convulsion like activities. (4)

Magnesium is a chemical gate-keeper, so calcium entry to nervous cell increases due to magnesium deficiency, and finally causes over stimulation, spasm and convulsion. (1)

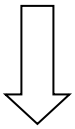
Glutamate is a major excitatory neurotransmitter in the brain acting as an agonist at N-methyl D-aspartate (NMDA) receptor. Extracellular magnesium normally binds to NMDA receptor channel producing voltage dependent block thereby decreasing synaptic transmission. (5)

Mechanism of seizure due to hypomagnesaemia is explained as follows.

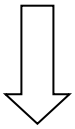
Hypomagnesaemia



1) Release of inhibition of voltage dependent gradient at NMDA receptor



Massive depolarization of neuronal network and burst of action

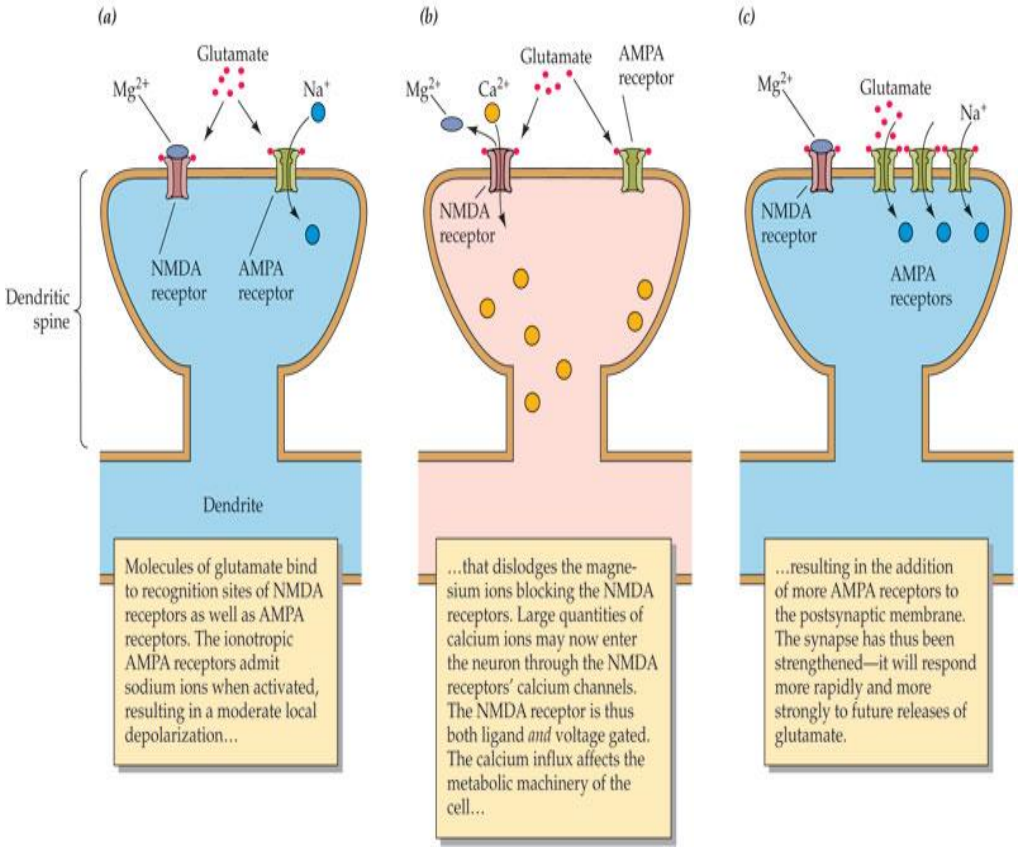


This leads to glutamate mediated depolarisation of the post synaptic membrane and enhancement of epileptiform electrical activity

2) Mg also acts as a voltage-dependent calcium channel antagonist, Thus hypomagnesaemia will leads to release of calcium ions, which causes nerve excitability. [6]

Mg also affects calcium metabolism as the production of cyclic adenosine monophosphate (cAMP) is Mg dependent, which in turn controls the release of parathyroid hormone. [1]

This study was conducted to estimate the serum magnesium levels in febrile seizures. If a correlation is established between hypomagnesemia and febrile seizures then magnesium supplementation will play a major role in the prevention of febrile seizures.



SEIZURES IN CHILDHOOD

A seizure is a transient occurrence of signs and/or symptoms resulting from abnormal excessive or synchronous neuronal activity in the brain.

Most seizures in children are provoked by somatic disorders originating outside the brain such as fever, infection, head injury, hypoxia, or toxins. Epilepsy is defined as two or more unprovoked seizures occurring with the interval greater that 24hrs apart. It is responsible for less than a third of seizures.

Infants and children have an increased tendency to develop seizures compared to adults. It reflects the imbalance between the excitatory and inhibitory system in children which leads to seizures. Therefore in certain conditions like high fever, infections, minor asphyxia, drugs, toxins and metabolic disturbances like hyponatremia, hypernatremia, hypocalcaemia tend to cause seizures in children.

Epileptic seizures are classified by International Classification of epileptic seizures broadly into two large categories.

1. **Focal seizures**:

In focal seizures, the first clinical and EEG changes suggest initial activation of a system of neurons limited to part of one cerebral hemisphere. It includes focal sensory seizures, gelastic seizures, hemiclonic seizures, secondarily generalized seizures & reflex seizures and focal epilepsy syndromes.

2. Generalized seizures:

In generalized seizures, the first clinical and EEG changes indicate synchronous origin from both hemispheres. It may present as tonic-clonic seizures, clonic seizures, typical absence seizures, absence with special features, tonic seizures, myoclonic seizures, myoclonic atonic seizures, negative myoclonus, atonic seizures & reflex seizures in generalized epilepsy syndromes.

Epilepsy:

Epilepsy is a disorder of the brain characterized by an enduring predisposition to develop seizures and by the neurobiologic, cognitive, psychologic, and social consequences of this condition. The clinical diagnosis of epilepsy usually requires the occurrence of atleast one unprovoked epileptic seizures with either a second such seizure or enough EEG and clinical information to convincingly demonstrate an enduring predisposition to developing recurrence.

Seizure disorder:

Seizure disorder is a general term that is usually used to include any 1 of several disorders, including epilepsy, febrile seizures, and possibly single seizures and symptomatic seizures secondary to metabolic, infectious, or other aetiologies like hypocalcaemia & meningitis.

Epileptic syndrome:

An epileptic syndrome is a disorder that manifests one or more specific seizure type and has a specific age of onset and a specific prognosis. It includes epileptic encephalopathy, Genetic epilepsy, Structural / metabolic epilepsy. [1]

FEBRILE SEIZURES

Febrile seizures are the most common type of seizures among the paediatric age group. Although described by ancient Greeks, it was not until this century that febrile seizure was recognized as a distinct syndrome separately from epilepsy.

In 1970's, Livingston [7] stated that children with febrile seizures have better prognosis with almost neurologically intact state, when compared with epileptic convulsions, which is not triggered by fever. The care of affected children is depends upon the familiarity in clinical diagnosis & prognosis.

Epidemiological studies have been useful in identifying features that carry adverse prognosis and these factors form the basis of proper seizure management and family counselling.

DEFINITION

In 1980, a consensus conference held by "National Institute of Health" described a febrile seizure as "An event in infancy or childhood usually occurring between three months and five years of age associated with fever, but without evidence of intracranial infection or defined

cause”[8] This definition is useful because it emphasizes age specificity and the absence of underlying brain abnormalities.

It does not exclude children with prior neurological impairment and neither provides specific temperature criteria nor defines a seizure.

In clinical practice,

NIH definition must be interpreted with caution because intracranial infection may not be readily apparent, especially in very young infants.

IDEAL DEFINITION

Febrile seizures defined as

- seizures that occurs between the age of 6 and sixty months,
- with a temperature of 38 degree C or higher,
- that are not the result of central nervous system infection,
- or any metabolic imbalance,
- And that occur in the absence of a history of prior afebrile seizures. [1]

This definition is the currently accepted one, which is followed everywhere.

PATHOPHYSIOLOGY

The pathogenesis of febrile seizure remains unexplained. Febrile seizure occurs in young children due to their lower level of seizure threshold. It was thought previously that, it occurs relatively early in infection usually during the raise phase of the temperature curve. But

later it was proved that the temperature hike does not relate to its occurrence. Rectal temperature may rise beyond 39.2°C and approximately 40% of seizures occur at 40.2°C. Upper respiratory tract infection, lower respiratory tract infection, otitis media, acute gastroenteritis are the common childhood infections documented in febrile seizure.

Endogenous pyrogens like interleukin 1β have a role in increasing neuronal excitability which may link with fever and seizure activity and is suggested by animal studies. [9] Studies in children suggest the hypothesis of cytokine network activation having a role in the pathogenesis of febrile seizures, but the precise clinical and pathological significance of these observations is not yet clear. [10,11]

AGE OF ONSET

The age of onset of febrile seizures is usually a bell shaped pattern in graphical representation. More than 90% of febrile seizures occur within the first 3 years of age and 10% after 3 years of age. 50% of febrile seizures appear during second year of life with peak incidence between 18-24 months.

We have to use the term febrile seizure cautiously in infant less than 6 months and in children more than 5 years. Seizures in these categories are relatively different in origin when compared to febrile seizures. For example meningitis should be suspected in infants less than 6 months.

GENETICS

Genetic predisposition plays a major role in febrile seizures. Risk of developing febrile seizure is 10% in siblings of children who experience febrile seizure. Risk of development of febrile seizure is increased to 50%, when parents are having febrile seizures. [13] Tsuboi et al study reported a concordance rate of 56% in monozygotic twins and 14% in dizygotic twins. Exact mode of inheritance is still not identified, even though there is clear evidence for genetic role in febrile seizures. [12] Polygenic inheritance is likely to occur in families. The clinical description of 'febrile seizure susceptibility trait' in certain families reveals autosomal dominant of inheritance with reduced penetrance. Sodium and GABA channel gene mutations are evident in these families.

Febrile seizure genes are mapped to chromosome 19p and 8q 13-21 according to linkage studies. Febrile seizure is a good example of complex interplay between two factors, one is genetic susceptibility and other is environmental factors. Most likely, all children have some increased susceptibility to seizures from fever at the specific age window, this being increased markedly by an underlying genetic influence.

GEOGRAPHIC DISTRIBUTION

In the United States 2-5% of children have febrile seizures by their fifth birthday. Similar rate of febrile seizure is found in Western Europe. The incidence elsewhere in the world varies as follows,

5-10% in India

8% in Japan

14% in Guam

0.5-1.5% in China [14]

SEX DISTRIBUTION [12]

Some studies demonstrate a slight male preponderance.

TYPES OF FEBRILE SEIZURE [1]

1. Simple febrile seizure:

- Simple febrile seizure is a generalised,
- Usually tonic clonic in nature,
- Lasting for not more than 15 minutes,
- And not recurrent within a 24-hr period.

Children with simple febrile seizures have a very short post ictal state and usually return to their basal level of consciousness and normal behaviour within few minutes of its occurrence.

Between 2% and 5% of neurologically healthy infants and children experience at least one febrile seizure, which is usually simple febrile seizures & it does not have the risk of mortality.

2. Complex febrile seizure:

- A complex febrile seizure is more prolonged (duration >15 minutes),
- And / or reoccurs within 24 hrs,
- Or when focal seizure activity or
- focal findings are present during the postictal period.

Children with complex febrile seizures have double the risk of mortality compared to general population.

3. Febrile status epilepticus is a febrile seizure lasting longer than thirty minutes.

4. Simple febrile seizures plus is the term used in children having recurrent febrile seizures within 24 hours.

COMMON ILLNESSES ASSOCIATED WITH FEBRILE SEIZURES

Viral infections are the predominant cause of febrile seizures. Rantala et al in 1995 has reported that 67% of febrile seizures are due to upper respiratory infection triggers. Among the viral infections influenza, dengue, rhino viruses are predominantly associated with febrile seizures.

Gastroenteritis, otitis media and lower respiratory tract infections are some of the other infections which are associated with febrile seizures. Febrile seizure is the most frequent extra intestinal

manifestation of shigellosis infection. This is due to direct neurotoxic effect of the shigella bacterium on central nervous system. Immunization related seizures also documented within 48 hrs of administration of vaccine.

Data from "National Collaborative Perinatal Project" indicated that age of onset, personal and family histories, and clinical presentations resemble those of febrile seizures from infectious causes.

RISK FACTORS FOR RECURRENCE

About thirty percent of children with a first febrile seizure experience recurrent seizures and fifty percent after 2 or more episodes.

The risk factors are as follows:

MAJOR

- Age <1year.
- Duration of fever is <24 hr.
- Fever 38-39 degree Celsius.

MINOR

- Family history of febrile seizures.
- Family history of epilepsy.
- Complex febrile seizure.
- Day care
- Male gender
- Lower serum sodium at the time of presentation.

Recurrence percentage based on above risk factor is as follows,

- No risk factors- risk is 12% for recurrence
- One risk factor-25 to 50% for recurrence
- 2 risk factors-50-59% for recurrence
- 3 or more factors-73-100% for recurrence

Fever Recurrence Risk

- If Onset of fever is < 1 hr. Recurrence is 44%
- 1 hour-24hours then recurrence is 24%
- For >24 hrs. Risk of recurrence will be 13%.

With each 1°F rise of temperature from 101°F to 105°F, recurrence risk decreases from 35% to 13% respectively.

RISK FACTORS FOR EPILEPSY

Five large cohort study data of children with febrile seizures suggest that epilepsy subsequently developed in 2%-10% of children who experienced febrile seizures. Several studies show that the risk of developing epilepsy after a single episode of febrile seizure is not different from risk of epilepsy in general population. The following factors are associated with greater risk of epilepsy. [15]

- Complex febrile seizures / focal complex febrile seizures.
- Presence of Positive family history of epilepsy.
- Febrile seizure occurring less than 1 hour of onset of fever.
- Recurrent febrile seizures.
- Neurodevelopment abnormalities.

The incidence of epilepsy is >30% when several risk factors are present compared with an incidence of 1% in children who have febrile convulsions and no risk factors. [16]

FEBRILE SEIZURES-MORBIDITY AND MORTALITY

The mortality is extremely low in febrile seizures. According to National Collaborative Perinatal Project [17] & the British Cohort Study [13], no deaths were reported. These studies could not explain the evidence of permanent motor deficits after febrile seizures. Extensive studies are available on cognitive abilities due to febrile seizures in children. The Collaborative Perinatal Project studies found that there is no difference in IQ scores at the age of 7 years between children with febrile seizures and their siblings. A recent study from Taiwan [14] comparing intelligence and behaviour, also found no difference in memory between children with febrile seizures including complex febrile seizures. These results are significant because febrile seizures appear to be of limbic origin and memory is subserved by the hippocampus.

ROLE OF OTHER TRACE ELEMENTS IN FEBRILE SEIZURES:

- Various trace elements are plays a role in febrile seizures by their co-enzyme activity or ability to influence ion channels and receptors.

- Studies have shown that magnesium, zinc, selenium, copper and iron play a significant role in febrile convulsions.
- Zinc (Zn) acts as a co-factor of glutamic acid decarboxylase, an enzyme which maintains the production of GABA in central nervous system and decreased level of Zn in CSF has also been observed in febrile seizure. [27,28]

Copper (Cu) inhibits Mg++-adenosine triphosphatase(ATPase) and Na+-K+-ATPase enzymes and disturbs the sodium and potassium homeostasis, which results in genesis of epileptiform discharges. [26]

Iron defeciency play a role in the occurrence of febrile seizures in children. Researchers found that serum ferritin levels were lower in children with febrile seizure than in children who had febrile illnesses without convulsions. [29]

Magnesium

Magnesium properties:

Magnesium is a common mineral and an essential biological cation which has a role in more than three hundred enzymatic reactions.[30]Calcium, Potassium, Sodium and Magnesium are considered to be the four major[31] required micronutrients needed for biological function. It is a group 2 element in periodic table with a atomic mass of 24.305 Da, melting point of 648.8° C, boiling point of 1090° C and a specific gravity of 1.738. [32] Magnesium will dissolve

easily in water. Its attraction towards water molecule makes it almost impossible to pass through narrow channels in biological membranes.

In contrast to calcium it binds with neutral nitrogen groups such as amino groups and imidazol in addition to oxygen especially in acidic group. But this binding is weaker than that of calcium which made it difficult to adapt and reach the deep protein binding sites. [33]

At birth human body contains 760mg of magnesium, which is increased to 5g at the age of 4-5 months and in adults it will be 25g. Considering whole body magnesium only 1% is present in extracellular fluid. In detail 0.3% of magnesium is present in serum, 0.5% in red blood cells, 19.3% in soft tissue, 27% in muscles and about 52.9% is present in bones. Magnesium present in bone acts as reservoir in stabilizing serum concentration. Plasma concentration range of magnesium should be between 0.75-1.00 mmol /L.

Magnesium acts as a cofactor in many enzymatic reactions. It is involved in energy metabolism, protein synthesis, RNA and DNA synthesis, also maintains electrical potential of nervous tissues and cell membranes. It has the role in regulating potassium fluxes and in calcium metabolism. Decrease in magnesium level results in depletion of muscle potassium as well as decreased plasma concentration of calcium. As it regulates the enzyme activity it controls calcium and potassium channels and promote membrane stabilization. It is also responsible for the maintenance of the transmembrane gradients of sodium and potassium.

It inhibits calcium induced cell death. It is anti apoptotic in mitochondrial permeability transition and antagonizes calcium overload triggered apoptosis. [34]

Magnesium has an essential physiological role which is achieved through its important properties:

- Its ability to bind with various ligands, especially ATP
- Its ability to compete with calcium for binding sites on proteins and membranes. [35]

It has a role of catalytic activity in more than 300 enzymes, [32]

Eg: ATPase, adenylate cyclase, creatine kinase, 5- phosphoribosyl pyrophosphate synthetase, phosphofructokinase, enolase, DNA polymerase, etc.

In specific it catalyzes the energy metabolic reactions including process of glycolysis, gluconeogeneis, respiratory chains, pentose phosphate pathway, krebs cycle, urea cycle, etc.

Other than its structural and dynamic function magnesium role is heterogeneous. Its small atomic radius helps to compete with other divalent cations specifically calcium for particular protein binding sites.

Because of its endogenous calcium antagonist behavior it blocks N-Methyl- D Asparate (NMDA) receptor. It is also involved in inhibition of excitatory neurotransmitter release, relaxation of vascular smooth muscle cells and blockage of Ca channels. It is necessary for maintaining normal neurological function and neurotransmitter release,

regulation of vascular tonus, muscular contractions or relaxations, blood pressure of cardiac rhythm, parathormone secretion and activity, insulin signal transmission, modulating the immunological functions, etc.., [30]

Other biological functions of magnesium:

Role of Mg in diabetes mellitus:

- Low Mg Level leads to reduced tyrosine kinase activity at insulin receptor level, impaired hormone and receptor level interaction.
- This will leads to insulin resistance & worsening the diabetes. So serum magnesium level is one of the independent predictor of diabetes mellitus.

Role of Mg in Obesity:

- Mg forms complex with dietary fat and prevent its absorption. It also stimulates adenyl cyclase activity that leads to increased cAMP production this will leads to obesity.

Role of Mg in Dyslipidemia:

- It activates the lipoprotein lipase and clears triglycerides from blood
- LCAT- present in HDL, which requires Mg for its action. LCAT converts cholesterol to its esters .HDL transports cholesterol from blood to liver.
- HMG CoA reductase is controlled by Mg-ATP complex , thus it controls the rate limiting step of cholesterol synthesis.

- Pyrophosphatase catalyzes the first step in lipid degradation. Mg is required for its activation.

Role of Mg in ADHD:

Erythrocytic Mg levels play a crucial role in ADHD. Na/Mg ion channels are the regulator of movement Mg ions from extracellular to intracellular. Genetic defect in these ion channels will reflect as reduced intracellular Mg. Several studies are evident that low level of erythrocytic Mg is associated with ADHD.

Role of Mg in thrombosis:

- Mg induces prostocyclin synthesis & release from endothelial cells and also stimulate platelet synthesis.
- Decreased Mg level is decreased guaylyl cyclise activity and reduced cGMP.This will lead to platelet aggregation.
- Reduced Mg levels associated with decreased fibrinolytic activity.

Sources:

Drinking water and food composition are the main source of magnesium. It is abundant in green leafy vegetables, grains, cereals, nuts and legumes. Dairy products are the poor source of magnesium. Vegetables, fruits, chocolates, meat and fish have intermediate values. Magnesium intake is forthrightly associated with energy intake.

Magnesium in drinking water specifically hard water contains upto 30mg/L.

Table: Food Sources of Magnesium:

	Serving Size	Magnesium (mg)
Vegetables and Fruits		
Prickly pear	1 fruit	88
Spinach, cooked	125 mL (½ cup)	83
Swiss chard, cooked	125 mL (½ cup)	80
Tamarind	125 mL (½ cup)	58
Edamame/baby soy beans, cooked	125 mL (½ cup)	52
Potato, with skin, cooked	1 medium	44-55
Okra, cooked	125 mL (½ cup)	50
Grain Products		
Cereals, All Bran	30 g (check product label for serving size)	84-97
Wheat germ cereal, toasted	30 g (¼ cup)	96
Quinoa, cooked	125 mL (1/2 cup)	63

Milk and Alternatives		
Cheese, soy	50 g (1½ oz)	114
Yogurt, soy	175 g (¾ cup)	70
Meats and Alternatives		
Legumes (dried beans, peas and lentils)		
Peas, black-eyed peas/cowpeas, cooked	175 mL (¾ cup)	121
Tempeh/fermented soy product, cooked	150 g (3/4 cup)	116
Soybeans, mature, cooked	175 mL (¾ cup)	109
Soy nuts	60 mL (¼ cup)	99
Beans (black, lima, navy, adzuki)	175 mL (¾ cup)	6

Table: Recommended Dietary allowances of Magnesium

GROUP	CATEGORY	MAGNESIUM (mg/day)
Man	Sedentary	340
	Moderate	
	Heavy	
Women	Sedentary	310
	Moderate	
	Heavy	
	Pregnant	310
	Lact. < 6 months	
	Lact. 6-12 months	
Infants	0-6 months	30
	6-12 months	45
Children	1-3 yrs	50
	4-6 yrs	70
	7-9 yrs	100
Boys	10-12 yrs	120
Girls	10-12 yrs	160
Boys	13-15 yrs	165
Girls	13-15 yrs	210
boys	16-17 yrs	195
Girls	16-17 yrs	235

Absorption:

- Magnesium homeostasis is maintained by the intestine, the bone and the kidneys.
- Primarily magnesium is absorbed in small intestine that is jejunum and ileum and significantly less in the colon, it depends on the factors such as fiber rich food, pH, Mg quantity, phytates, intestinal passage, meal volume and viscosity, vitamin D, polyphenols, calcium, oxalates, zinc, phosphorous, etc.
- Absorption occurs mainly via passive paracellular(60-70%) and to lesser extent by transcellular mechanisms (20-30%). [32]

Excretion:

- Kidneys are the major regulator which controls the serum magnesium concentration through urinary excretion.
- It is filtered in glomerules and 90-95% of the filtered quantity is promptly reabsorbed in thick ascending limb of Henle's loop. Reabsorption occurs at a lesser extent in proximal tubules and distal tubules and 3-5% is excreted.
- It is influenced by various factors like: Serum magnesium levels, GFR, Volume status, Hormones like PTH, Calcitonin, ADH, insulin and glucagon, and hypophosphatemia, acid base status, hypercalcaemia, etc. [32]

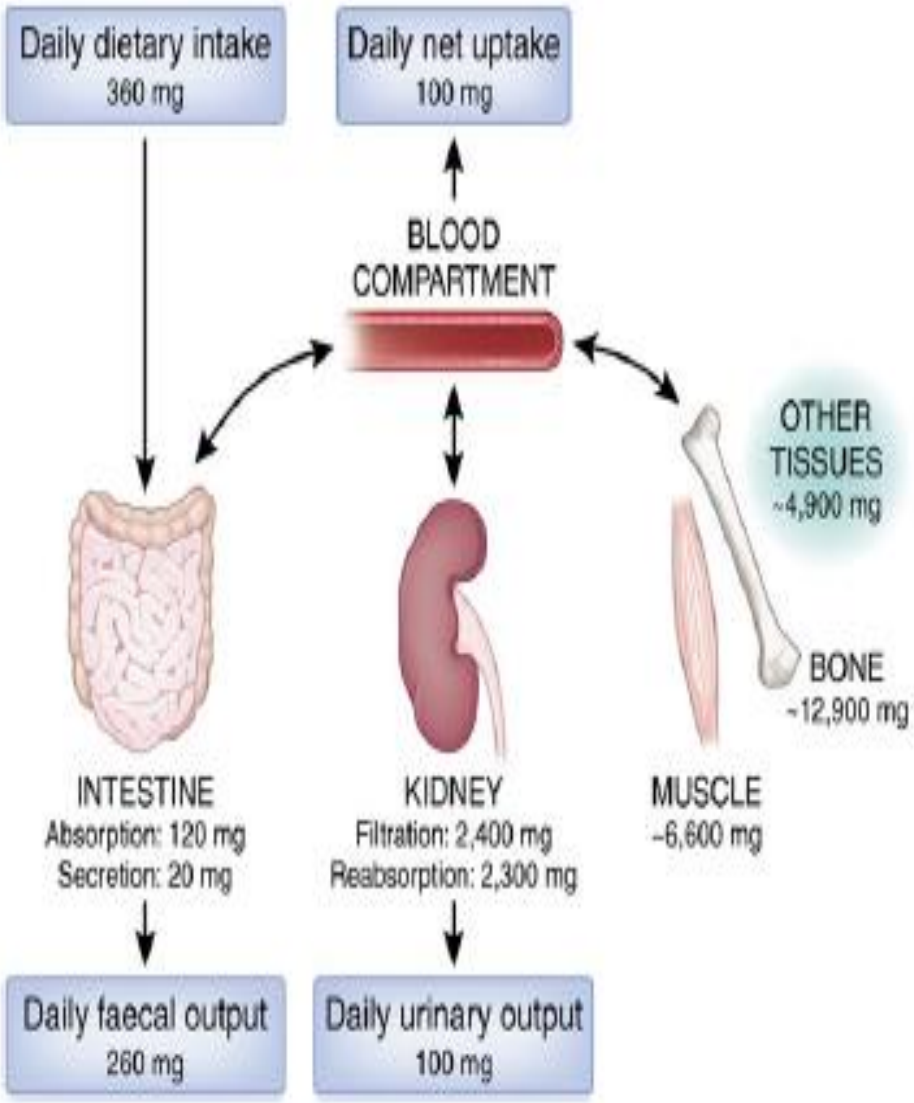


Fig: Magnesium Metabolism in Human Body

Table: Clinical features of Magnesium deficiency:

System involved	Effects
Central nervous system and Neuromuscular system	Convulsions Muscle weakness Muscle cramps Carpopedal spasm Chorea Athetoid
Cardiovascular system	Arrhythmias Hypertension
Electrolyte disturbance	Hypocalcaemia Hypokalemia
Miscellaneous	Asthma Altered glucose homeostasis

Table: Causes of Hypomagnesaemia

GI causes	Reduced intake Dietary deficiency Magnesium free IV fluids
	Reduced absorption Mal absorption Chronic diarrhoea Primary infantile hypomagnesaemia
Renal loss	Renal failure Diuretics,Bartter's syndrome Gitlemen syndrome
Endocrine causes	Hypocalcaemia Hyperthyroidism Hyperaldosteronism
Drugs	**Antibiotics-** Gentamicin, Amikacin,
	Antifungal- Amphotericin B,
	Immunosuppressants- cyclosporins
Redistribution of magnesium	Refeeding insulin therapy Hungry bone syndrome Massive blood transfusion Correction of acidosis Catecholamine excess
Miscellaneous	Pamidronate , Forscarnet

Table: Effects based on serum levels of magnesium

Serum Mg levels(mmol/L)	Clinical features
<0.5	Tetany,convulsions,Arrhythmias
0.5-0.7	Neuromuscular irritability
0.7-1.0	Normal levels
1.0-2.1	Without symptoms
2.1-2.9	Lethargy, sleepiness, redness, nausea, vomiting, hyporeflexia.
2.9-5.0	Drowsiness, hypotension, ECG changes
>5.0	Heart block,apnea,paralysis,coma

ASSESSMENT OF SERUM MAGNESIUM LEVEL

Photo metric method:

- Most common method used widely
- Formazan dye forms a complex with magnesium at alkaline PH which measured by photometry.

Free ionic magnesium:

- Ionized Mg measured by ionic selective electrode

Enzymatic method:

- Hexokinase , isocitrate dehydrogenase are used to estimate the serum levels of Mg.

Atomic absorption method:

- It is the accurate method of measuring serum Mg levels.
- Instruments are costly & require expertise for the procedure.

REVIEW OF LITERATURE

Namakin K et al study was done to determine the serum trace elements magnesium, calcium, sodium, potassium and zinc in febrile seizure and its comparison with those of fever without seizure. This case control study was conducted on 48 children aged between 6 months to 5 years who presented with febrile seizures and age matched controls. Mean serum magnesium levels are 1.9±0.32 mg/dl in cases and 2.27±0.38 in controls with significant p value of <0.001. This indicates that serum magnesium level was significantly lower in febrile convulsion compared to children with fever without seizures. [37]

Sreevasaiah Bharathi et al studied the serum magnesium levels and its correlation with febrile convulsions in children aged between 6 months and 5 years. It was an observational prospective study, done in 120 children over a period of one year. Out of 104 cases of simple febrile seizures 19 shows hyomagnesemia with the p value of 0.0124 & in 16 cases of atypical febrile seizures showed hypomagnesemia with p value of 0.014.This study revealed strong correlation between the occurrence of simple febrile seizure and lower levels of serum magnesium. [38]

Ahmad Talebian et al study was done to determine the relation between serum zinc & magnesium levels in children with febrile

convulsion. This study was conducted as analytical case control study in 60 children in each group, age of 3 months to 6 years. The mean serum magnesium level was 2.21mg/dl in cases and 2.39mg/dl in controls with the significant p value of 0.003.It was concluded that there was a relationship between low levels of serum magnesium and occurrence of febrile convulsion in children. (39)

Dr Iyswarya et al study was done to estimate the serum zinc, copper, magnesium and plasma malondialdehyde levels in children with febrile seizure. This study involves 20 cases 20 controls.The mean serum magnesium level of 1.99±0.08, in cases and 2.33±0.09, controls with the p value of <0.001, was statistically strongly significant. The study conducted that the mean serum magnesium levels were significantly decreased in febrile seizure compared to control group. (40)

Prasad et al study done was to compare the relationship between the cerebrospinal fluid and serum zinc, copper, magnesium & calcium levels in children with seizures. This was a case control study conducted on 40 children who presented with febrile seizures from 1 yr to 14 yrs & 40 healthy children as controls. The mean serum magnesium levels 0.87±0.34 mg/dl in cases, 0.93±0.08 mg/dl in control with the p value of 0.564. The mean CSF magnesium levels are1.03±0.58 mg/dl in cases, 1.31±0.18 mg/dl in controls with p value of 0.145.This study

revealed that serum magnesium level did not correlate with the occurrence of febrile seizures. [41]

Y.Sreekrishna et al study was done to determine the relationship between serum magnesium level and febrile convulsion in children. This was a case control study involving 100 study subjects & 100 controls. The mean serum magnesium level is 2.1±0.15 mg/dl in cases, 2.13±0.22 mg/dl in controls with the p value of 0.233 which is not statistically significant. This study revealed that there was no significant correlation between the serum magnesium levels and the occurrence of the febrile seizures in children. [42]

Nabid Khosroshahi et al study was done to evaluate the magnesium levels in serum and cerebrospinal fluid of patients with febrile convulsions. This was a case control study involving 90 children admitted with febrile convulsions & 100 healthy children as controls. The mean serum magnesium levels 2.26±0.27 mg/dl in cases and 2.27±0.22 mg/dl in controls with the p value of 0.87.The mean CSF magnesium levels 2.36±0.19 mg/dl in cases, 2.3±0.24 mg/dl with the p value of 0.53.Both these p values were not statistically significant hence no significant relationship exists between serum & CSF magnesium levels and febrile convulsions. [43]

N.Rutter et al studied the levels of calcium, magnesium and glucose in serum & CSF in children with febrile convulsion. This study was done in 83 patients over a period of one year in children presenting with febrile convulsion. The mean plasma magnesium was 2.3±0.2 mg/dl which is normal. The mean CSF magnesium level 2.75±0.34 mg/dl which is normal. There was no significant difference between both these levels. [44]

Dr. Sherlin et al study was done to estimate of serum magnesium level in children with febrile convulsions & was compared it with normal children. It was a prospective analytical case, done on 50 children with febrile convulsion and in normal children over the period of one year. It was concluded that serum magnesium levels had a significant correlation in children with febrile convulsion. [45]

AIM AND OBJECTIVES

PRIMARY OBJECTIVE

- To determine the association between serum magnesium levels and febrile seizures.

SECONDARY OBJECTIVE

- To compare the serum magnesium level in simple febrile seizures & complex febrile seizures

STUDY JUSTIFICATION

Although the exact etiology of febrile seizures is still not identified, most of childhood idiopathic seizures have been attributed due to alteration in levels of trace elements like zinc, copper, selenium and magnesium. Among the trace elements, magnesium has got the significant correlation with seizure activity by its direct action on membrane stabilization and nerve conduction. Among the studies so far that have been conducted in our region, majority shows significant correlation & few has negative correlation. Hence this study is planned to determine the association between serum magnesium levels and febrile seizures. If we prove the significant association between hypomagnesaemia and febrile seizures there arises a question of whether magnesium supplementation in children will prevent the occurrence of febrile seizures.

STUDY PLACE:

Institute of child health & Hospital for children, Egmore, Chennai - 600 008.

STUDY DESIGN:

Case control study

STUDY POPULATION:

Children in study age group 6 months to 5 years admitted in the paediatric ward at Institute of Child health & Hospital for Children, satisfying the inclusion criteria.

INCLUSION CRITERIA:

CASES:

- Cases are defined as seizures that occurs between the age of 6 and sixty months, with a temperature of 38° C or higher, that are not the result of central nervous system infection or any metabolic imbalance, and that occur in the absence of a history of prior a febrile seizures. [(1)]

CONTROLS:

- Age & sex matched children admitted in paediatric ward with fever but without seizures.
- Fever in controls was defined as axillary temperature above 99°F or Oral temperature above 100°F.

EXCLUSION CRITERIA:

- Children admitted with acute CNS infection,
- Known case of seizure disorder,
- Developmental delay.

STUDY PERIOD:

February 2017- August 2017

SAMPLE SIZE:

With previous study, reporting a mean Mg level of 1.9 in cases and 2.27 in controls with a standard deviation of 0.38 with an alpha error of 5% and beta error of 10% a sample size of 36 in each group is required. To further increase the power of our study we chose a study population of 100 cases and 100 controls.

MATERIALS AND METHODS

This case control study was conducted over the period of 7 months from February 2017 to August 2017 at Institute of child health & Hospital for children, a tertiary care teaching hospital in Chennai.

This study included cases of 100 children aged between 6 months and 5 years presented with febrile seizure & age and sex matched controls of 100 Children admitted with fever without seizures.

Informed consent of the parents of the two groups of children was obtained in a printed consent form in Tamil as the predominant population were from Tamilnadu. Any questions or doubts were cleared by the examining physician in Tamil and the signature of the parent or left hand thumb impression was obtained.

Institution review board clearance was obtained. Prior to inclusion of the children in the study, a detailed history of the presenting complaints were recorded which included duration of fever, time of onset of seizures, type of seizures, duration of seizures, past history of seizures and family history of seizures.

In addition, history suggestive of any triggering factors for the febrile episode like cough and cold, nasal discharge, ear discharge, burning micturition or crying during micturition were also recorded.

Vital signs namely heart rate; respiratory rate and blood pressure were measured and recorded. The axillary temperature was recorded in

all children with the digital thermometer placed in the axilla for one minute. Anthropometric measurements namely weight, height, mid-arm circumference and head circumference were recorded as per standard guidelines.

This was followed by general examination and systemic examination in detail. Those children who showed features of any chronic congenital or acquired illnesses were excluded. Those who showed features suggestive of intracranial infection like altered sensorium, meningeal signs, bulging anterior fontanel etc were also excluded.

Three millilitres of whole blood was collected by venipuncture under strict aseptic precautions in sterile metal free acid propylene washed plastic test tube. The sample was allowed to stand without any disturbance for five hours to enable settling down of erythrocytes.

Then the serum was separated by centrifuging at 2500 revolutions per minute under aseptic conditions. Serum blood sugar, serum levels of sodium, potassium, total calcium & ionised calcium were estimated & entered in excel sheet. Adequate serum was transferred to acid washed plastic collection tube which was properly labelled for the measurement of serum magnesium.

The tube was sealed tightly and stored in the freezer compartment at -20° Celsius of the refrigerator at Institute of child health & Hospital for children.

LABORATORY ASSESSMENT OF MAGNESIUM

Method:

- Absorption spectrometry method

Principle:

- Serum magnesium ions are identified while it reacting with Xylidyl Blue in alkaline solution.
- This complex will produce red colour, which was measured by spectrometrically.
- The magnesium concentration is directly proportional to the intensity of the colour change.
- By using EGTA calcium interference is virtually eliminated.
- Protein interference is eliminated by using surfactant system.

Reagent composition:

- Xylidyl blue 0.1mM
- EGTA 0 .13mM
- DMSO1.4M
- Buffer
- Surfactant
- Non reactive stabilizers including KCN at 0.02 %W/V

Analyser name:

- Hitachi 717 Auto-Analyser

Procedure:

- The sample we are analysed are brought to room temperature and transfer these samples to inverting tubes.
- Labelling was done appropriately for cases and controls.
- Working reagent prepared according to the instructions.
- 0.01 ml of reagent poured into each test tubes by using pipette ml.
- 0.1 ml of sample added to the representative tube & mix well
- Test tubes are incubated at 37◦C 3 minutes.
- After incubation, zero spectrometry blink with the reagent at 550 nm.
- Reading done and recorded.
- Calculation done by using following given formula.
- Suitable linearity-4.86 mg/dl.

ANALYSIS & RESULTS

STATISTICAL ANALYSIS & RESULTS

This study was conducted at Institute of child health & Hospital for children, Egmore to compare the serum magnesium levels in children with febrile convulsions, febrile children without seizures. The data collected was entered by a data entry operator and analysed by a statistician using SPSS software. The following test statistics were used in the analysis.

1. Chi -Square test.
2. Two sample T test.
3. Bivariate Correlations.
4. One way analysis of Variance.

DEMOGRAPHIC DATA

Table: AGE DISTRIBUTION

AGE	GROUP		TOTAL
	CASES	CONTROL	
<1YR	20(20%)	20(20%)	40(20%)
1-2YR	38(38%)	38(38%)	76(38%)
2-3YR	19(19%)	19(19%)	38(19%)
3-4YR	11(11%)	11(11%)	22(11%)
4-5YR	12(12%)	12(12%)	24(12%)
TOTAL	100(100%)	100(100%)	200(100%)

P value 0.829

In the febrile convulsions group 58% of children were below 2 years of age, 19% between 2 to 3 yrs, 11% between 3 to 4 yrs and 12% were between 4 to 5 yrs of age.

Our study reveals majority of children developed febrile seizure are between 1 to 2 years.

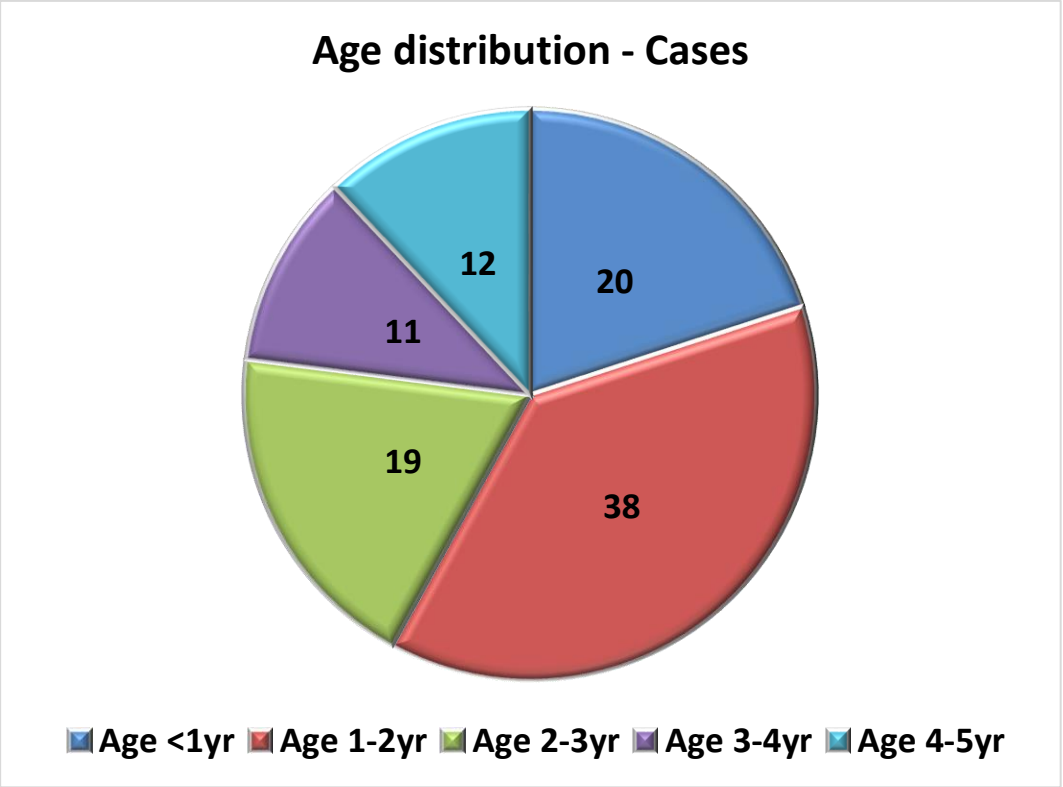


Fig: Age distribution in febrile seizures

Table: SEX DISTRIBUTION

SEX	GROUP		TOTAL
	CASES	CONTROL	
MALE	62(49.6%)	63(50.4%)	125(100%)
FEMALE	38(50.67%)	37(49.33%)	75(100%)
TOTAL	100(50%)	100(50%)	200(100%)

P value 0.098

In our study male children were 62% female children were 38%.This reveals male sex are more prone to develop febrile convulsions.

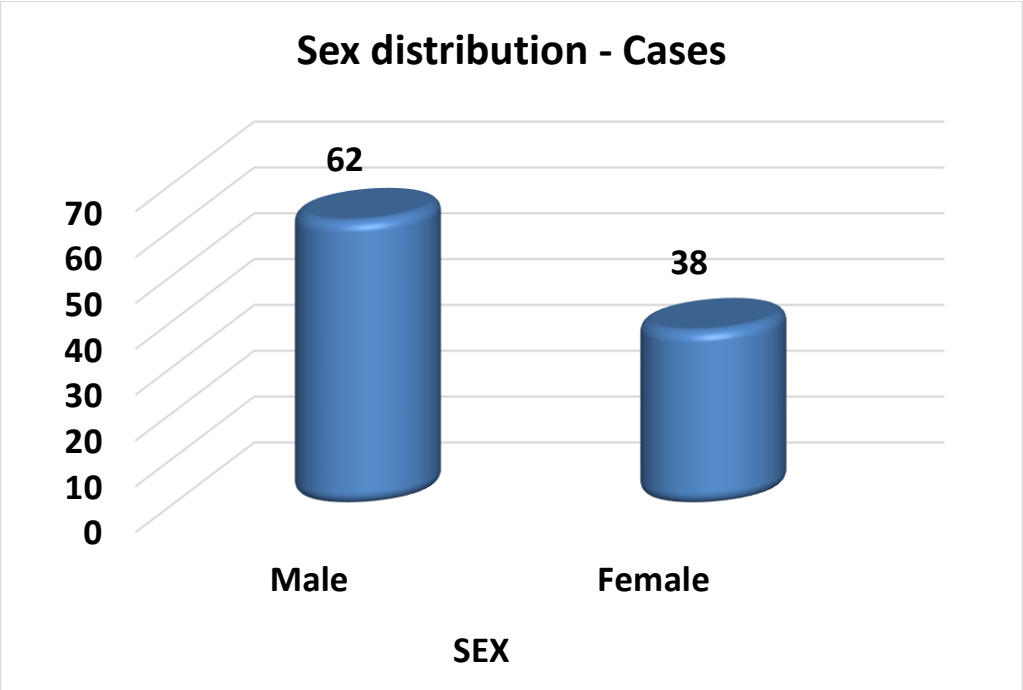


Fig: Sex distribution chart in febrile convulsion group

TABLE: PREDOMINANT TYPE OF FEBRILE SEIZURE

SEX	FEBRILE SEIZURE		TOTAL	P-VALUE
	SIMPLE	COMPLEX		
MALE	48(77.42%)	14(22.58%)	62(100%)	0.899
FEMALE	29(76.32%)	9(23.68%)	38(100%)	
TOTAL	77(77%)	23(23%)	100(100%)	

In our study 77% cases were belonged to simple febrile seizure and 23% were belonged to complex febrile seizure. It was concluded that simple febrile seizures are the predominant type in our study.

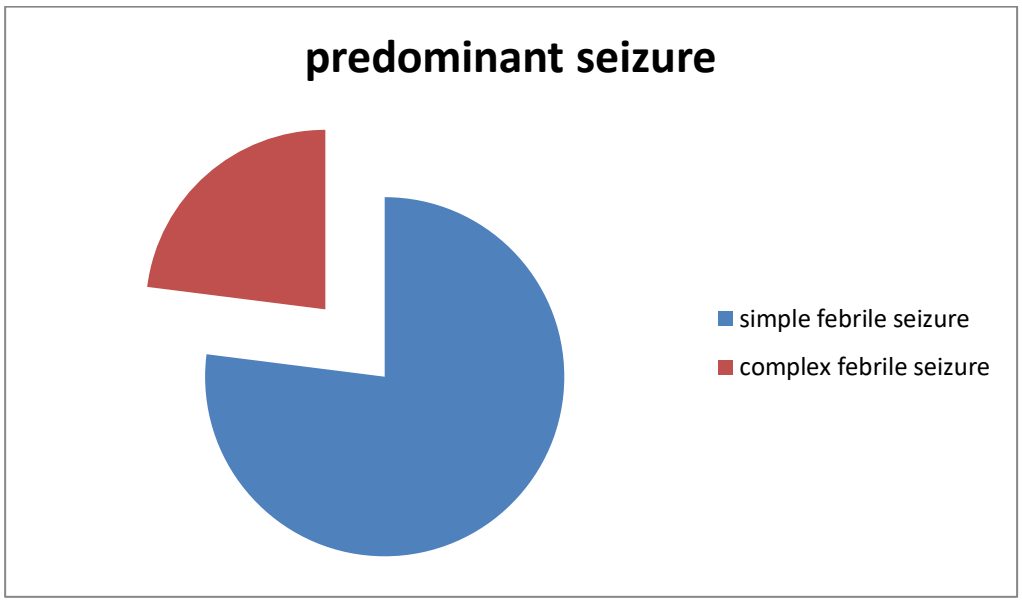


Fig: Predominant seizure type showed in pie diagram

TABLE: SOCIOECONOMIC STATUS (SES)

SOCIOECONOMIC STATUS	GROUP		TOTAL
	CASES	CONTROL	
CLASS- II	60 60.0%	54 54.0%	114 114%
CLASS-III	40 60.0%	46 46.0%	86 86%
TOTAL	100 100.0%	100 100.0%	200 200.0%

P=0.826 not significant.

- In the febrile convulsions group 60% belong to modified Kuppusamy scale class II, 40% belong to modified Kuppusamy scale class III.
- In the control group 54% belongs to modified Kuppusamy scale – class II & 46% belong to modified Kuppusamy scale -class III.
- This P value 0.826, which is statistically insignificant, hence the occurrence is not related to socioeconomic status.

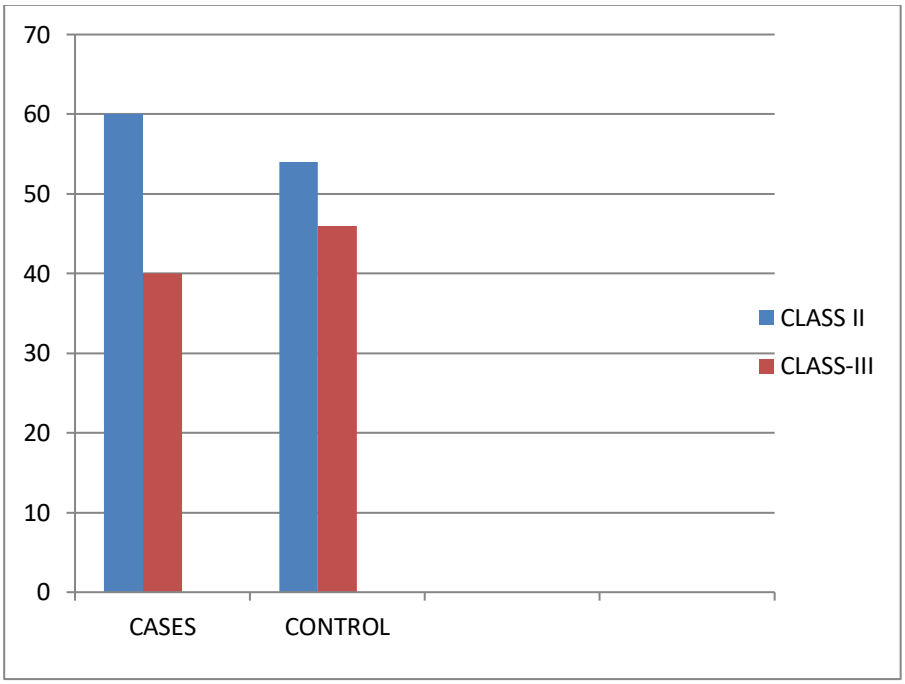


Fig: Comparison of socioeconomic status.

TABLE: FAMILY HISTORY IN RELATION TO FEBRILE SEIZURES

Family history	CASES	CONTROL	TOTAL
nil - Number % within GROUP	90 90%	100 100%	190 190%
Father- Number % within GROUP	2 2%	0 0%	2 2%
Mother-Number % within GROUP	2 2%	0 0%	2 2%
Sibling-Number % within GROUP	6 6%	0 0%	6 6%
Total	100 100%	100 100%	200 200%

P value 0.111- not significant.

- In the febrile convulsions group 90% of the children did not have Positive family history of febrile convulsions.
- Four children had positive family history of febrile convulsions in the parent and three children gave positive family history in the siblings. In control group none of them had positive family history of febrile convulsions.

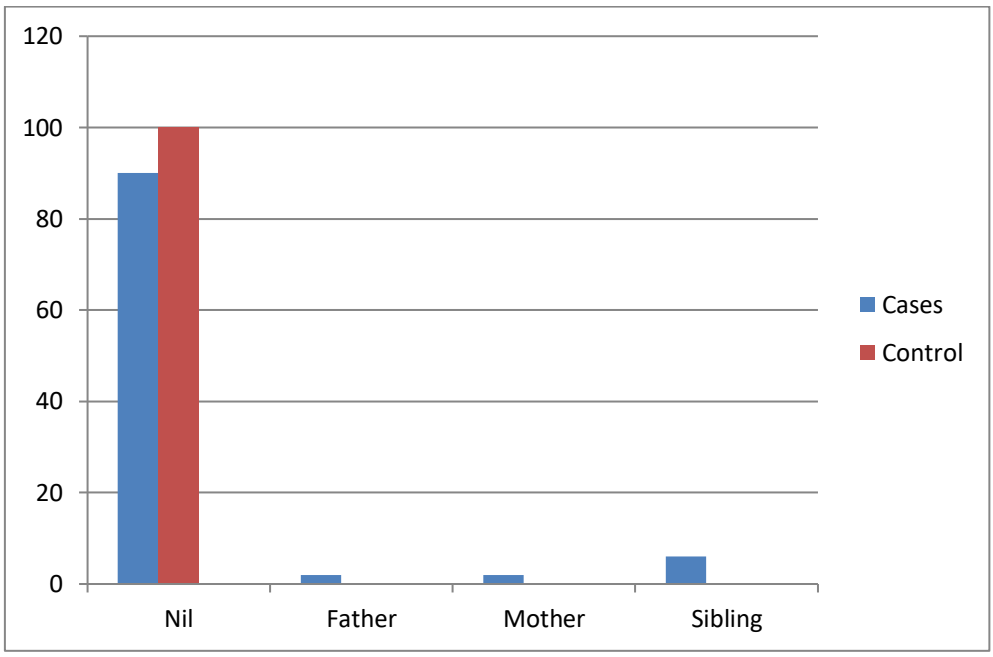


Fig: Family history of febrile seizure

TABLE: FOCUS OF INFECTION

FOCUS OF INFECTION	CASES	CONTROL	TOTAL
Upper respiratory infection	54 54%	12 12%	76 76%
Lower respiratory infection	12 12%	28 28%	40 40%
Pnuemonia	0 0%	12 12%	12 12%
Acute gastroenteritis	12 12%	18 18%	30 30%
Urinary tract infection	4 4%	6 6%	10 10%
ASOM	2 2%	2 2%	4 4%
No foci	16 16%	22 22%	38 38%
Total	100 100%	100 100%	200 200%

P value 0.743- not significant.

- Upper respiratory tract infection was found to be the triggering illness for febrile convulsion in 54 children out of 100 constituting 54%.Incidence of acute gastroenteritis, acute suppurative otitis media, lower respiratory tract infection, urinary tract infection was found to be 24%, 4%,12% & 4% respectively. No localising signs were found in 16% of the children.

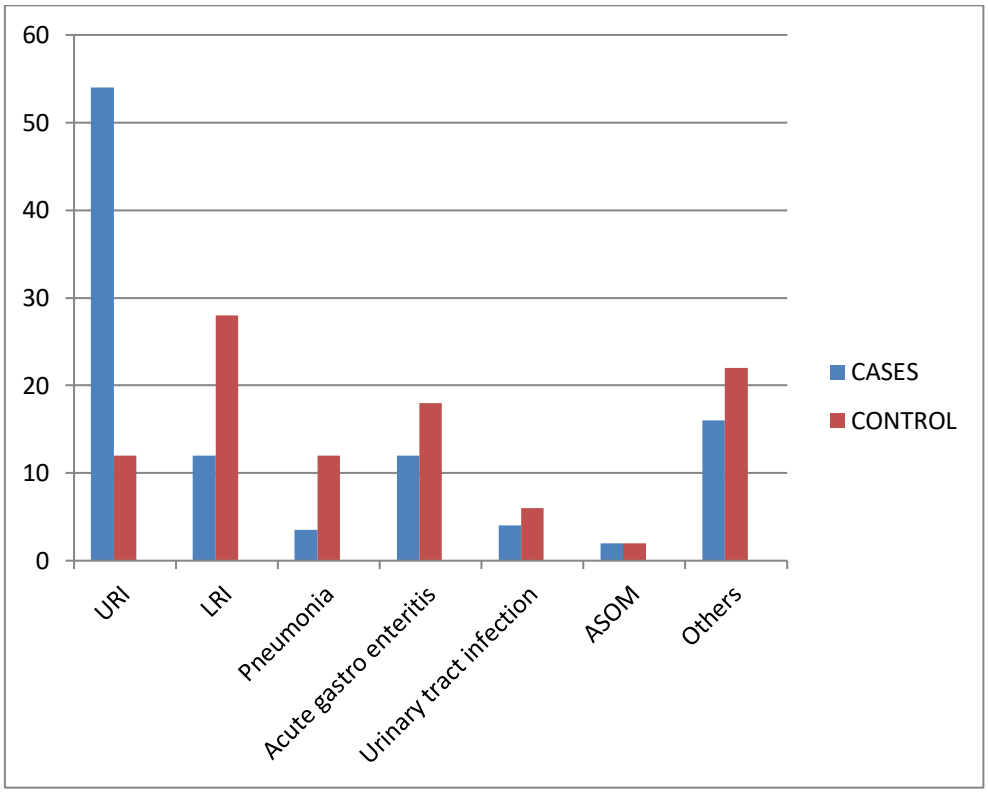


Fig: Focus of infection in febrile seizures.

TABLE: NUTRITIONAL STATUS IN RELATION TO FEBRILE SEIZURES

ANTHROPOMETRY	GROUP		TOTAL	P-VALUE
	CASES	CONTROL		
NORMAL	83(54.97%)	68(45.03%)	151(100%)	0.018
MODERATE	12(30%)	28(70%)	40(100%)	
SEVERE	5(55.56%)	4(44.44%)	9(100%)	
TOTAL	100(50%)	100(50%)	200(100%)	

- In febrile seizure cases 83 had normal anthropometric status,12 cases belonged to moderate acute malnutrition and 5 belonged to severe acute malnutrition.
- In control cases 68 had normal anthropometric status, 28 cases belonged to moderate acute malnutrition and 4 belonged to severe acute malnutrition.
- This indicates that malnutrition is not preponderant in febrile convulsions.

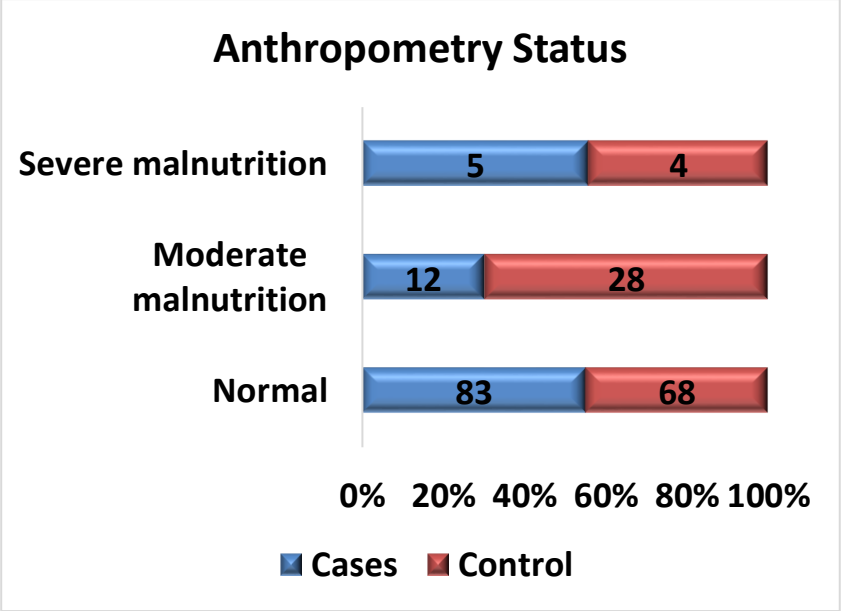


Fig: The children in the two groups were compared with respect to their nutritional status.

TABLE: ANAEMIA PREVALANCE IN OUR STUDY

ANAEMIA	GROUP		TOTAL	P-VALUE
	CASES	CONTROL		
YES	79(58.52%)	56(41.48%)	135(100%)	0.001
NO	21(32.31%)	44(67.69%)	65(100%)	
TOTAL	100(50%)	100(50%)	200(100%)	

- In febrile seizure cases 79(58.52%) cases are having anaemia, 21(32.31%) cases are not having anaemia.
- Among controls 56(41.48%) are having anaemia, 44(67.69%) cases are not having anaemia.
- Anaemia is more prevalent in febrile convulsion, which is compared to controls with the statistically significant P value.
- Many studies proved that the coexistent anaemia is a risk factor to develop febrile seizure, our study also proves that anaemia coexistence is one of the strongest risk factor for developing febrile seizures.

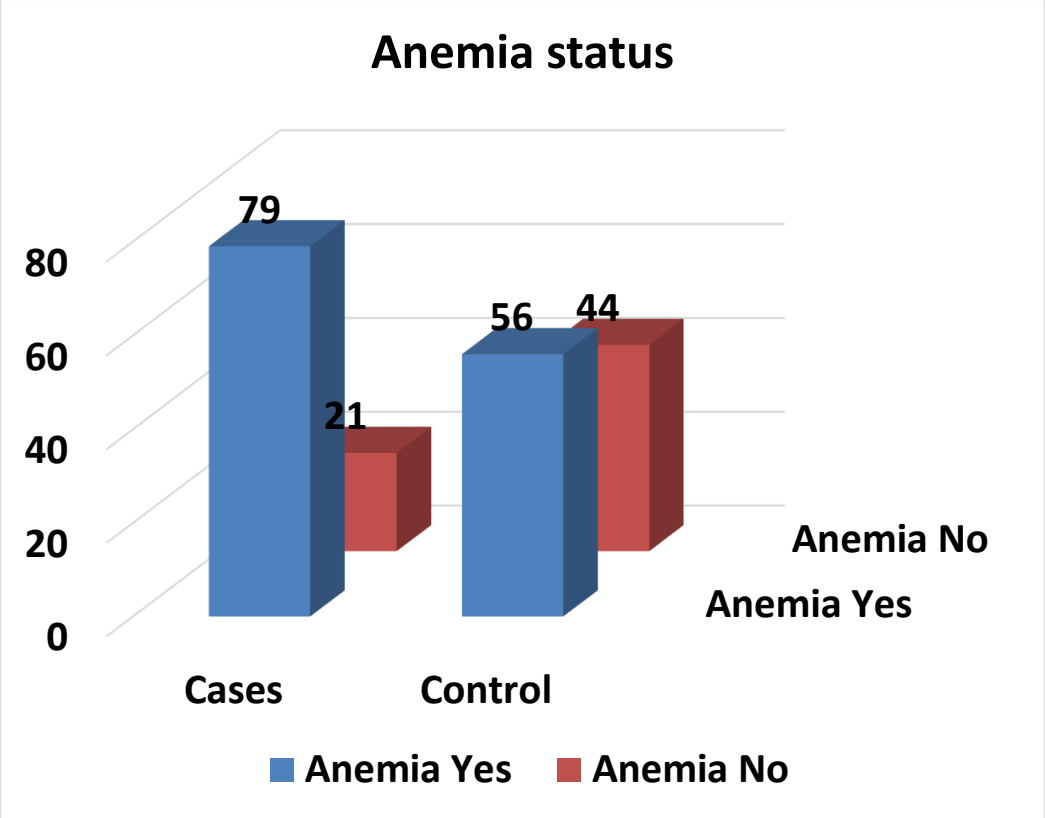


Fig: Anaemia prevalence in cases and controls

TABLE: SERUM MAGNESIUM LEVELS COMPARISON BETWEEN CASES AND CONTROLS

SERUM MAGNESIUM	GROUP		TOTAL	P-VALUE
	CASES	CONTROL		
NORMAL	74(44.85%)	91(55.15%)	165(100%)	0.002
ABNORMAL	26(74.29%)	9(25.71%)	35(100%)	
TOTAL	100(50%)	100(50%)	200(100%)	

GROUP	N	SERUM MAGNESIUM		P-VALUE‡
		MEAN	STD. DEV.	
CASES	100	2.04	0.29	0.097
CONTROL	100	1.98	0.23	

The mean serum magnesium level in children with febrile seizures was 2.04 mg/dl, and in controls was 1.98 with the standard deviation of 0.29 and 0.23 respectively.

While comparing the serum magnesium levels between febrile seizures and controls, with the P value of 0.097 it is not statistically significant.

It reveals there is no association between low levels of serum magnesium and febrile seizures.

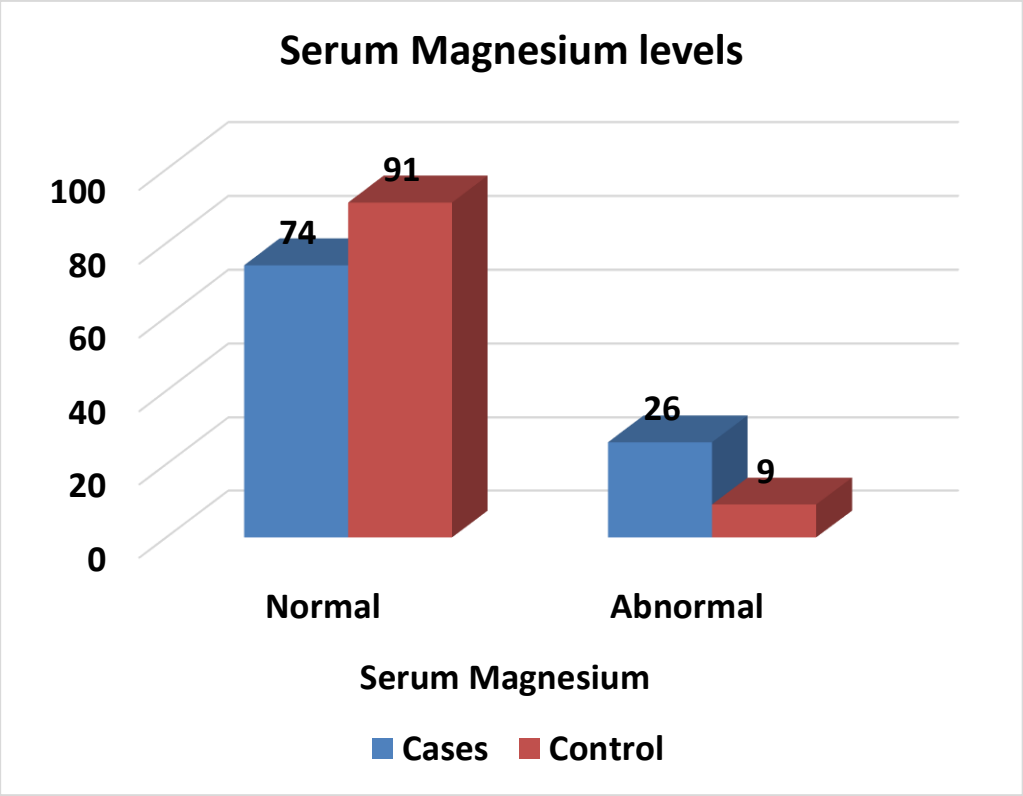


Fig: Comparison of serum magnesium levels between cases and controls

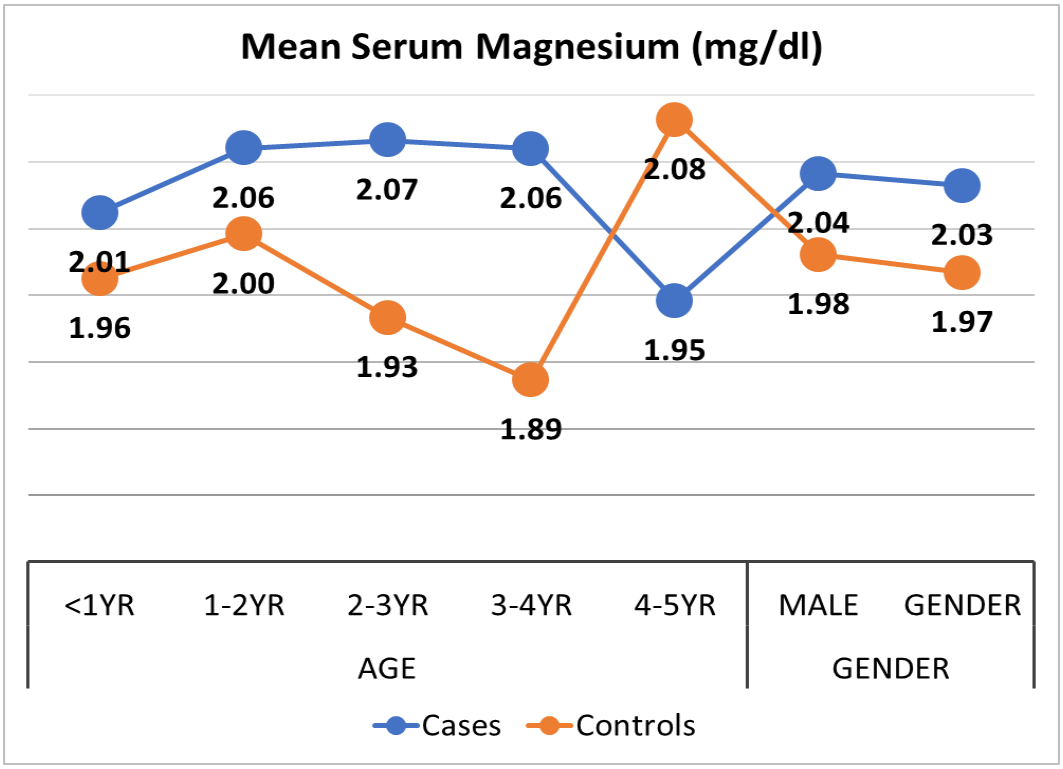


Fig: Serum magnesium levels are compared age wise in cases & controls

TABLE: COMPARISION OF SERUM MAGNESIUM LEVELS BETWEEN SIMPLE FEBRILE SEIZURES AND COMPLEX FEBRILE SEIZURES

TYPE OF SEIZURES	NO	SERUM MAGNESIUM		P-VALUE
		MEAN	STD. DEV.	
SIMPLE	77	2.04	0.31	0.933
COMPLEX	23	2.03	0.25	

- The mean serum magnesium levels in simple febrile seizures are 2.04 mg/dl with standard deviation of 0.31and in complex febrile seizures, 2.03 mg/dl with standard deviation of 0.25.
- The P value of 0.933, which is statistically insignificant.
- It concludes that there is no significant difference in the serum magnesium levels between simple and complex febrile seizures.

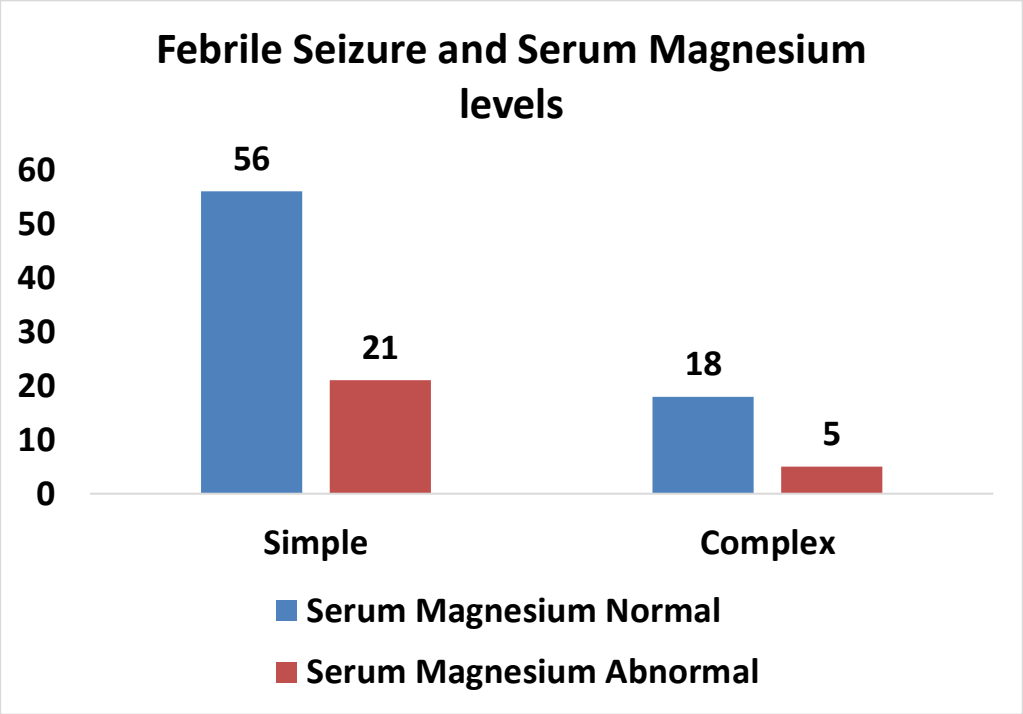


Fig: Serum magnesium levels in comparison with simple & complex febrile seizures

TABLE: TOTAL SERUM CALCIUM LEVEL IN RELATION TO CASES AND CONTROLS

GROUP	SERUM CALCIUM LEVEL TOTAL (mg/dl)		TOTAL	P-VALUE
	NORMAL	ABNORMAL		
CASES	90(90%)	10(10%)	100(100%)	0.001
CONTROL	100(100%)	0(0%)	100(100%)	
TOTAL	190(95%)	10(5%)	200(100%)	

PARAMETERS		ODDS RATIO	95% CONF. INTERVAL		P-VALUE
SERUM CALCIUM LEVEL TOTAL (mg/dl)	SERUM MAGNESIUM LEVELS (mg/dl)	1.34	0.35	5.20	0.668
	GROUP	0.04	0.00	0.78	0.033

- In our study 90% of cases have normal total serum calcium level and 10% have abnormal serum calcium level & all controls having normal total serum calcium level with the statistically significant P value of 0.001.
- This reveals that hypocalcaemia has a significant role in children with febrile seizure.
- In addition, total serum calcium level is not having any significant changes in relation to the serum magnesium level in both groups.

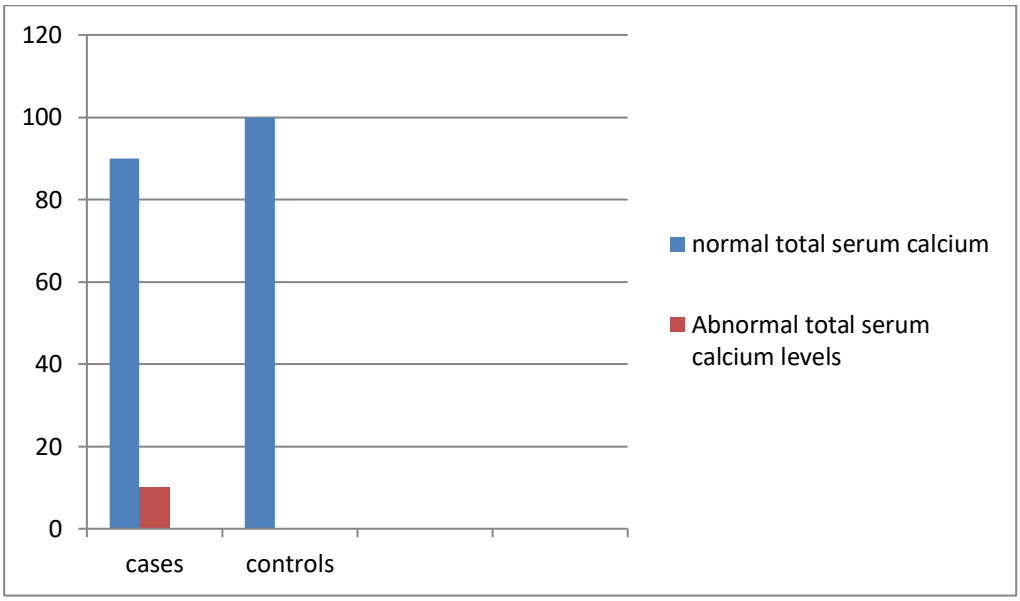


Fig: Total serum calcium levels in relation to cases and controls

TABLE: SERUM IONIZED CALCIUM LEVELS IN RELATION TO CASES AND CONTROLS

GROUP	IONIZED SERUM CALCIUM (mg/dl)		TOTAL	P-VALUE
	NORMAL	ABNORMAL		
CASES	88(88%)	12(12%)	100(100%)	0.831
CONTROL	87(87%)	13(13%)	100(100%)	
TOTAL	175(87.5%)	25(12.5%)	200(100%)	

PARAMETERS		ODDS RATIO	95% CONF. INTERVAL		-P-VALUE
IONIZED SERUM CALCIUM (mg/dl)	SERUM MAGNESIUM LEVELS (mg/dl)	1.63	.45	5.93	0.457
	GROUP	0.98	0.42	2.31	0.967

- Among cases 88% have normal ionized serum calcium level and 12% have abnormal serum ionized calcium level. In controls 87% have normal serum ionized calcium level and 13% have abnormal level.
- It reveals that the serum ionized calcium levels is not having significant correlation in children with febrile seizures.
- It also reveals that the serum ionized calcium levels are not having significant changes in relation to serum magnesium levels.

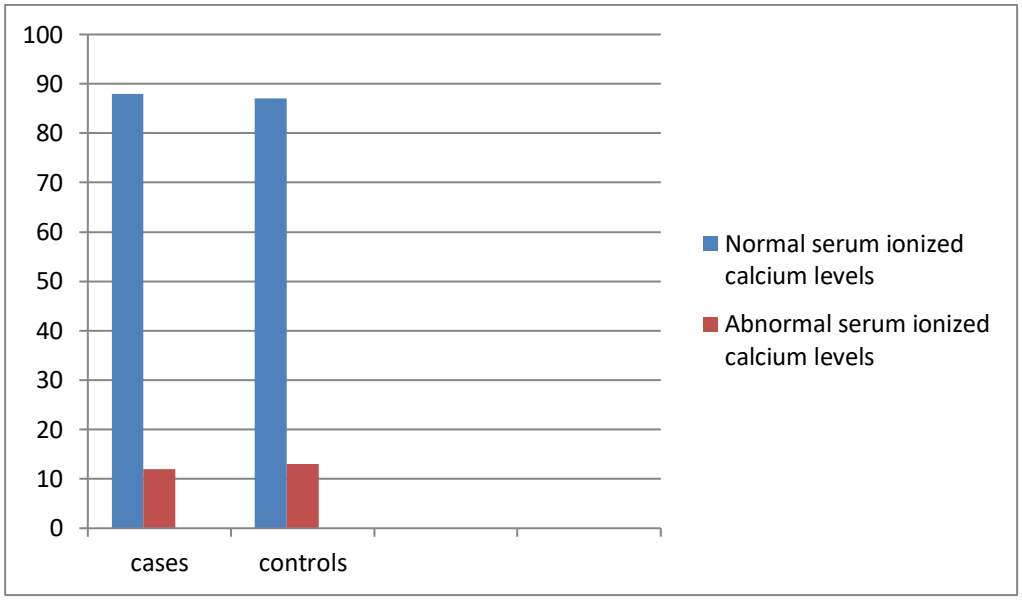


Fig: Serum ionized calcium levels in relation to cases and controls

TABLE: SERUM SODIUM LEVELS IN RELATION TO CASES AND CONTROLS

GROUP	SERUM SODIUM LEVEL (mEq/L)		TOTAL	P-VALUE¥
	NORMAL	ABNORMAL		
CASES	77(77%)	23(23%)	100(100%)	<0.001
CONTROL	95(95%)	5(5%)	100(100%)	
TOTAL	172(86%)	28(14%)	200(100%)	

PARAMETERS		ODDS RATIO	95% CONF.INTERVAL		P-VALUE§
SERUM SODIUM LEVEL (mEq/L)	SERUM MAGNESIUM LEVELS(mg/dl)	0.48	.15	.54	.219
	GROUP	0.16	.06	.44	.321

- Among cases 77% having normal serum sodium level and 23% having abnormal serum sodium level. In controls 95% having normal serum sodium level and 5% having abnormal level.
- It reveals that hyponatremia is having significant correlation in children with febrile seizures.
- It also reveals that the serum sodium levels are not having significant changes in relation to serum magnesium levels.

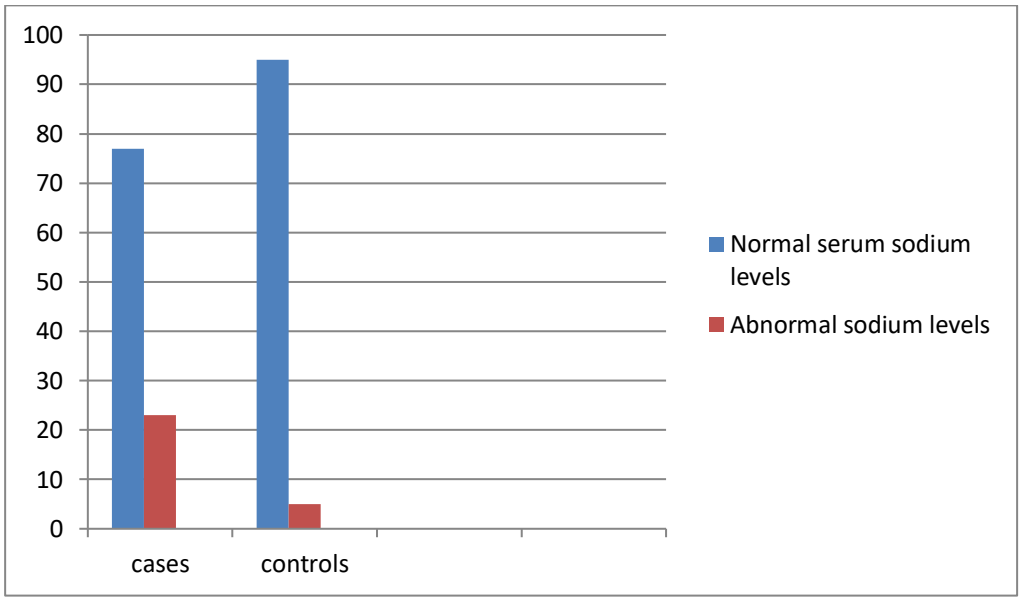


Fig: Serum sodium levels in relation to cases and control

TABLE: MEAN VALUES OF GLUCOSE, SODIUM, POTASSIUM, TOTAL & IONIZED CALCIUM

PARAMETERS	CASES	CONTROL	OVERALL
BLOOD GLUCOSE LEVELS ON ARRIVAL(mg/ dl)	89.77±15.78	86.38±11.62	88.08±13.93
SERUM SODIUM LEVEL (mEq/L)	135.95±2.21	138.01±2.49	136.98±2.57
SERUM POTASSIUM LEVEL (mEq/L)	4.26±0.39	4.18±0.3	4.22±0.35
SERUM CALCIUM LEVEL TOTAL (mg/ dl)	9.51±0.62	9.41±0.39	9.46±0.52
IONIZEDSERUM CALCIUM (mg/ dl)	4.25±0.2	4.2±0.17	4.22±0.19

The mean value of random blood sugar level is 89.77 mg/dl in cases and 86.38 mg/dl in controls. This explains that the random blood sugar levels are in same range for both groups.

The mean value of serum sodium level is 135.95 mEq/Lin cases and 138 mEq/L in controls. This study reveals that the serum sodium levels in cases are low when compared with controls.

The mean value of serum potassium, serum total and ionized calcium level of cases and controls are of having no significance while comparing its values.

TABLE: ANALYSIS OF FEBRILE SEIZURE GROUP

Variables	MEAN	STD. DEVIATION	N
Age (in months)	23.53	14.81	100
Serum magnesium levels (mg/dl)	2.04	0.29	100
Interval between fever onset and seizure in hours	8	6,12	100

- The mean age of the febrile seizures was found to be 24.5 months i.e 2 years.
- The mean serum magnesium level in febrile convulsion was 2.04 mg/dl.
- The mean fever-seizure interval was 8 hours.

TABLE: SERUM MAGNESIUM LEVELS IN RELATION TO GENDER

SEX	SERUM MAGNESIUM					
	CASES			CONTROLS		
	N	MEAN	STD. DEV.	N	MEAN	STD. DEV.
MALE	62	2.04	0.33	3	1.98	0.26
FEMALE	38	2.03	0.22	7	1.97	0.18

P value 0.4768

- The mean serum magnesium level in cases was 2.04 mg/dl in male children, 2.03 mg/dl in female children with standard deviation of 0.33, 0.22 respectively.
- The mean serum magnesium level in control was 1.97mg/dl in male children, 1.98 mg/dl in female children with standard deviation of 0.26, 0.18 respectively.
- It was concluded that there is no significant differences noted in serum magnesium levels between gender.

TABLE: CORRELATIONS

PARAMETERS	SERUM MAGNESIUM (N=100)	
	CORRELATION COEFFICIENT¥	P-VALUE
NO OF EPISODES	0.0889	0.3793
DURATION OF SEIZURE	0.0748	0.4596
INTERVAL BETWEEN FEVER ONSET&SEIZURES‡	-0.0474	0.6397

- Bivariate correlation test was used for the variables like age, fever seizure interval with respect to serum magnesium level.
- From the above table, there is no correlation between the above said parameters and serum magnesium level.

TABLE: TYPE OF SEIZURES IN CASES

TYPE OF SEIZURES	SEX		TOTAL	P-VALUE¥
	MALE	FEMALE		
GTCS	11(17.74%)	4(10.53%)	15(15%)	0.329
GTCS WITH UPWARD GAZE	40(64.52%)	23(60.53%)	63(63%)	
UPWARD GAZE	11(17.74%)	11(28.95%)	22(22%)	
TOTAL	62(100%)	38(100%)	100(100%)	

- Among male children GTCS with upward gaze was present in 40 cases, GTCS in 11 cases & upward gaze in 11 cases.
- Among female children GTCS with upward gaze was present in 23 cases, GTCS in 4 cases & upward gaze in 11 cases.
- There is no significant difference in gender in related to type of seizures.
- GTCS with upward gaze was the predominant seizure type in our study.

Table: AGE GROUP WISE SERUM MAGNESIUM LEVELS

AGE	SERUM MAGNESIUM						P value
	CASES			CONTROLS			
	N	MEAN	STD. DEV.	N	MEAN	STD. DEV.	
<1YR	20	2.01	0.23	20	1.96	0.20	0.096
1-2YR	38	2.06	0.27	38	2.00	0.25	0.072
2-3YR	19	2.07	0.33	19	1.93	0.26	0.018
3-4YR	11	2.06	0.42	11	1.89	0.25	0.933
4-5YR	12	1.95	0.31	12	2.08	0.13	0.6397

- The mean serum magnesium level <1 year,1-2 years,2-3years,4-5 years are 2.01mg/dl,2.06 mg/dl,2.07mg/dl,2.06 mg/dl,1.95mg/dl respectively.
- The mean serum magnesium level <1 year,1-2 years,2-3years,4-5 years are 1.96mg/dl,2.00 mg/dl,1.93mg/dl,1.89mg/dl,2.08mg/dl respectively.
- This signifies that there is no difference in serum magnesium level between these age groups.

DISCUSSION

This study was conducted to determine the role of serum magnesium level in children with febrile convulsion which was compared to febrile children without convulsion. These two groups of children were compared with respect to their age, sex, nutritional status and socioeconomic status.

The mean age of febrile seizure was 23.5 months in this study. Namakin K et al study reported a mean age of 24 months and all other studies reported mean age of onset between 20 and 27 months. [37]

Occurrence of febrile seizures of about 57% in our study is most commonly between 1 to 2 yrs followed by 2 to 3 yrs. Like our study, Ahmad Talebian et al study reported that maximum cases of febrile seizures occured during 1 to 3 yrs, but the percentage of about 48% which is low compared to our study. [39]

Family history of febrile seizure was occurred in 10% of children with febrile seizure in this study. This is significantly less when compared to other studies like Siddique et al , in which family history of febrile seizure is about 30%.[46] Saidul haque has reported 20% of positive family history in children with febrile convulsion in his study. [47] Farwell et al reported 29% positive family history in his study .[48] All these studies revealed that earliest occurrence of febrile seizure in children with positive family history. The mean age of presentation was 18.8 months in our study, which is less compared to 20 months in other

studies as a whole. Similar incidence was reported by Plochl et al in his study. [49]

Sex distribution in our study has a seizure predilection towards male children with 62% and with 38% in females. Namakin K et al reported that occurrence of febrile seizures has a predilection towards male.[37] In Talebian study the sex ratio was not similar to our study, but there was no significant differences in the prevalence of febrile seizure.[39]

In our study, upper respiratory tract infection accounts for 54% of children with febrile seizures. In addition 12% of children presented with acute gastroenteritis and 4% presented with urinary tract infections in our study. In 16% of children there were no localizing signs associated with fever. Upper respiratory tract infection as the most comment trigger followed by tonsillitis was also reported at N.Rutter et al study. [44]

In our study the mean serum magnesium levels were 2.04 mg/dl and 1.98mg/dl in children with febrile convulsion, febrile children without convulsion respectively. Similar results are demonstrated in Y.sreekrishna et al, Nahid Kkhosroshahi et al, N.Nutter et al, Burhanoglu study, Donalson, [42,43,39,49,51].However the mean serum magnesium levels in these studies are high when compared to our study. In contrast to our study Talebian, Prakash, Papierkowski Namakin et al ,Sreenivasaiah et al, Dr.sherlin banu et al revealed that the serum

magnesium levels are significantly lower than compared to normal children but those studies was done in limited cases [39,41,52,37,45].

Our study compared the serum magnesium level between simple febrile seizure and complex febrile seizure. The mean serum magnesium level was 2.04 mg/dl in simple febrile seizures and 2.03 mg/dl in complex febrile seizures .It was noted that there is no significant difference noted between two types. Ahmad Talebian et al study also has reported the similar findings. [39]

The serum magnesium levels did not show any significant correlation with age of onset, gender & the fever onset and seizure interval in our study. All the previous studies have shown similar findings in this aspect.

In our study the mean serum magnesium level in children with febrile seizure was found to be 2.04 mg/dl which is mid value of the normal reference level of 1.7 to 2.3mg/dl. The mean serum magnesium level in N.Rutter and Y.Sreekrishna studies were 2.3mg/dl and 2.1 mg/dl respectively. The mean serum magnesium level in controls was 1.98 mg/dl which is slightly lower than the children with febrile seizures. In Ahmad Talebian, Namakin, N.Rutter studies the mean serum magnesium levels are in upper limit of normal levels. [39,37,44] This explains that the serum magnesium levels are not having significant correlation with the occurrence of febrile seizures.

In Prasad study, sample sizes were much lower than compared to our study .Children in control group in that study had CNS infection that may be the reason for the different results in Prasad study.[41]

In Mroczkowski, Papierkowski studies the serum magnesium levels are compared with normal healthy children and it was done in lesser sample size. Compared to our study, sample size is less in these studies & we compared the serum magnesium levels between febrile seizure children and in febrile children without seizures. [52, 53]

Papierkowski compared Mg levels of serum and CSF between 18 children with febrile seizure and 15 healthy children. Inconsistency between results could be due to the differences between control groups in two studies which were healthy instead of febrile children or because of lower sample size in Papierkowski study.[53]

Chhaparwel studied magnesium levels of serum and CSF were compared among 100 children with febrile seizure and normal level of magnesium in the study area. It was found that the values are significantly lower in children with febrile seizure. Repeat serum magnesium levels were found to be increased in cases. [65]

Over all reason for the differences in results among various studies were due to number of cases or controls. For example, in Nahid Khosroshahi study cases were 49 and in our study number of cases were 100. Similarly considering controls, in Papierkowski study healthy

children were selected for study whereas in ours children had fever without seizures were considered. [53]

In Talebian's study, number of controls analysed were 60 while in our study, the number of controls be 100 could also be a reason for the differences in results. Age selection bias was another dissimilarity between both these studies. [39]

Derakhshan's study was conducted on lower sample size compared to this study. In this study 25% of children were had lower serum magnesium levels. The control group consisted of healthy children, while in our study febrile children without seizures were assessed. The controls in our study were not the healthy ones, these might also be a reason for the complication in comparing the serum magnesium levels of both studies. [66]

Saadnejad's cross-sectional study was conducted on 102 participants, which had similar levels of serum magnesium in contrast to our study. [67]

Serum calcium levels in our study is having significant role in children with febrile seizures. But mean serum calcium level in case and controls are similar. These results are similar with that of Namakin study[37]. In contrast Al- Haekim's, Azar nickvar study results showed that the serum calcium level had no role in febrile seizures. [68,69]

Decreased serum sodium levels in our study favouring the relation between hyponatremia and febrile seizures. In cases the mean serum sodium level in our study is 135.95mEq/L. Similar report was given in namakin study. [37]In contrast to our study, Azar nickavar study stated that serum electrolytes were normal in febrile seizures. [69]

CONCLUSION

- In our study all the case subjects had serum magnesium levels within the normal range, with a mean of 2.04 mg/dl.
- This study shows that serum magnesium levels are normal in children with febrile seizures. It indicates that serum magnesium may not have a significant role in the pathogenesis of febrile convulsions.
- Our study also revealed that, there is no significant difference in serum magnesium levels between simple and complex febrile seizures.
- Our study revealed that, there is significant association between hyponatremia, hypocalcaemia and febrile convulsions.
- There was no significant association between hypoglycaemia and febrile seizures.
- It was concluded that there was no association in children with febrile seizure of various age groups, gender in relation to serum magnesium levels.

LIMITATIONS OF THE STUDY

- Our study sample was not representative of entire population because all children were mostly from surrounding urban area.
- This study does not include children with recurrent febrile seizures. So far no studies were done to estimate the serum magnesium levels on recurrent febrile seizure.

RECOMMENDATIONS

- Erythrocytic Mg level estimation may be more useful in establishing a relation between hypomagnesemia and febrile seizures as in ADHD also. So future studies estimating erythrocytic magnesium levels in febrile seizures may be recommended.
- Estimating the levels of other micronutrients like zinc, selenium, copper and iron in febrile seizures may throw light on probable etiology.

ANNEXURE

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DATA COLLECTION FORM

IDENTIFICATION

1.Study Id-

2.Out patient/Inpatient number-

3.Name-

DEMOGRAPHIC CHARACTERISTICS

4.Age - a)DOB-

b)Actual(in yrs, months)-

5.Sex -1:Male 2:Female 3:Others

HISTORY

6.Duration of fever-

7.Onset & duration of seizure in relation with fever-

8.Type of seizure-

9.History related to fever-

10.Family history of seizure-

11.Diet history-

ANTHROPOMETRY

12.Weight in kg-

13.Height-

14.Anthropometry status based on WHO & IAP Growth -charts

CLINICAL EXAMINATION

15.General examination findings-

16.Systemic examination:

CVS:

RS:

ABDOMEN:

CNS:

INVESTIGATIONS

17.Complete Haemogram :TC- DC- Hb - PCV- Platelets- MCV/MCH- MCHC- RDW- RBC count-

18.Serum Electrolytes:

Sodium- Normal/Elevated/Decreased

Potassium- - Normal/Elevated/Decreased

Calcium (Total & Ionised)- Normal/Elevated/Decreased

19.Serum Magnesium- Normal/Elevated/Decreased

20.CSF Findings (If needed):

21. Neuro imaging (If needed):

PATIENT INFORMATION SHEET

Place of study – Paediatric ward ,Institute of Child health and Hospital for Children,Egmore,Chennai-8.

Name of the Investigator : Dr .SELVARAJU.K

Name of the Participant: **Age:** **Sex:**

Hospital number:

Study title: "ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA"

We request you to allow your child to participate in the study.

Aim of the study-

Aim of my study is to determine the serum levels of magnesium & its relation with febrile convulsions.

Method-

For the above aim, we will be checking your child vitals & anthropometric measurement. Further, we intend to draw 3 ml of venous blood from your child along with blood drawn for other tests prescribed by your doctor and send it for analysis .This will take approximately ten minutes.

Can I refuse to participate in the study?

Participation in the study is purely voluntary .You may refuse to participate or withdraw from the study at any time .In both cases the

treatment and care your child receives from this hospital will not be affected in any manner.

Benefits and harms of participating in the study-

Your child will not benefit directly by participating in this study. But by way of participating in this study, your child is contributing to the update of science which may benefit him/her and many other patients with this disease in future.

Drawing 3 ml blood from your child may be perceived as harm, but medically this will not compromise her/him health .Further your child will not be poked separately for this test, because blood for this test will be collected along with the other tests as advised by your treating paediatrician.

Confidentiality-

The data collected from this study will be used for the purpose of study only .The results of this study will be published .Personal information of the children participating in the study will be kept confidential. There will not be any disclosure about your child's information without your permission.

Subject rights-

If you wish further information regarding your child's rights as a research participant, you may contact the principal investigator in the mobile number or address mentioned below.

Principal Investigator - Dr. SELVARAJU.K

Mobile number - 9787701880

Contact Address -Institute of child Health and Hospital for Children , Egmore, Chennai – 08.

Place:

Date: Signature of Parent / Guardian

INFORMED CONSENT FORM

Study place: Paediatric ward**,** Institute of child Health and Hospital for Children, Egmore.

Title of the study: "ROLE OF SERUM MAGNESIUM LEVELS IN FEBRILE SEIZURES- A CASE CONTROL STUDY FROM A PAEDIATRIC REFERRAL CENTRE IN SOUTH INDIA"

Name of the investigator: Dr SELVARAJU.K

Name of the participant: **Age & Sex:**

Hospital number:

1. I have read and understood the patient information sheet provided to me regarding the participation of my child in the study.
2. I have been explained about the nature of the study and had my questions answered to my satisfaction.
3. I have been explained about my rights and responsibility by the investigator.
4. I will allow my child to co-operate with the investigator and undergo clinical tests subjected during the study whole heartedly.
5. I have advised about the risks associated with my child's participation in this study
6. I am aware of the fact that, I can opt out of the study at any time without having to give any reason and this will not affect my child's future treatment in this hospital.

7. I hereby give permission to investigators to release the information obtained from my child as result of participation in this study to medical journals/conference proceedings.
8. I understand that my child's identity will be kept confidential if my child's data are publicly presented/published.
9. I have decided my child can participate in the research study .I am aware if I have any question during this study ,I should contact investigator.
10. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

Name and Signature/thumb impression of the parent/guardian

Name:……. Signature: ……

Date: …….

Name and Signature of the investigator

Name:…… Signature: …….

Date: …….

Name and Signature of the impartial witness-1

Name: …… Signature: ……

Date:……..

Name and Signature of the impartial witness-2

Name:…… Signature: …….

Date: …….

தகவல் படிவம்

ஆய்விடம்: அரசு குழந்தைகள் நல மருத்துவமனை மற்றும் ஆராய்ச்சி நிலையம், எழும்பூர், சென்னை- 600008

முதன்மை ஆராய்ச்சியாளர்: மரு க.செல்வராஜ்

பங்கு பெறுபவரின் பெயர்:

வயது: **பாலினம்:**

மருத்துவமனை எண்:

சோதனை மாதிரியின் எண்:

ஆய்வு தலைப்பு:

காய்ச்சலினால் வலிப்பு ஏற்படும் குழந்தைகளில் மக்னீசியம் தாது உப்பின் அளவு மற்றும் அதன் பங்களிப்பு தொடர்பான ஆய்வு.

நோக்கம்:

காய்ச்சலினால் வலிப்பு ஏற்படும் குழந்தைகளில் மக்னீசியம் தாது உப்பின் அளவு மற்றும் அதன் பங்களிப்பு தொடர்பான ஆய்வு மேற்கொள்ளப்படுகிறது.

செய்முறை:

உங்கள் குழந்தையின் நாடித்துடிப்பு, சுவாச எண்ணிக்கை மற்றும் இரத்த அழுத்தம் அளவீடு செய்யப்படும், அத்துடன் குழந்தையின் எடை, உயரம் அளவீடு செய்யப்படும். மிகவும் சுத்தமான சூழ்நிலையில் குழந்தையின் உடலில் இருந்து சிரையின் மூலமாக 3 மில்லி லிட்டர் இரத்தம் சேகரிக்கப்பட்டு பரிசோதனைக்கு அனுப்பி வைக்கப்படும்.

ஆய்வில் பங்கேற்க மறுத்தால்?

இந்த ஆய்வில் பங்கேற்பது முற்றிலும் உங்களது சொந்த விருப்பமே, தாங்கள் எப்போது வேண்டுமானாலும் இவ்வாராய்ச்சியிலிருந்து விலகி கொள்ளலாம். தாங்கள் விலகி கொள்வதால் உங்கள் குழந்தைக்கு அளிக்கப்படும் சிகிச்சையில் எந்த வித மாற்றமோ, பாதிப்போ இருக்காது.

பங்கேற்பதின் இலாப மற்றும் நஷ்டங்கள்:

இந்த ஆய்வில் இருந்து பெறப்படும் தகவல்கள் நம் நாட்டை நோயில்லாத நாடாக மாற்ற உபயோகப்படும். இவ்வாறு நாட்டின் வளர்ச்சியில் பங்கேற்ற பெருமை உங்களையும், உங்கள் குழந்தையையும் சேரும்.

இரகசியத் தன்மை:

ஆய்வில் இருந்து பெறப்படும் தகவல்கள் வெளியிடப்படும் போது உங்கள் மற்றும் உங்கள் குழந்தையின் அடையாளம் இரகசியமாக வைக்கப்படும்.

பங்கேற்பவரின் உரிமை:

இந்த ஆய்வைப் பற்றி மேலும் தகவல் அறிய தொடர்பு கொள்ள வேண்டிய நபர்:

முதன்மை ஆராய்ச்சியாளர்: மரு க.செல்வராஜ்

கைபேசி எண்: 9787701880

முகவரி: மூன்றாம் ஆண்டு முதுநிலை மருத்துவ மாணவர்,

அரசு குழந்தைகள் மருத்துவமனை மற்றும் ஆராய்ச்சி நிலையம்,

எழும்பூர், சென்னை- 600008

பெற்றோரின் கையொப்பம்

தேதி:

இடம்:

ஒப்புதல் படிவம்

ஆய்விடம்: அரசு குழந்தைகள் நல மருத்துவமனை மற்றும் ஆராய்ச்சி நிலையம், எழும்பூர், சென்னை- 600008

முதன்மை ஆராய்ச்சியாளர்: மரு க.செல்வராஜ்

பங்கு பெறுபவரின் பெயர்: **வயது:** **பாலினம்:**

மருத்துவமனை எண்:

சோதனை மாதிரியின் எண்:

ஆய்வு தலைப்பு:

காய்ச்சலினால் வலிப்பு ஏற்படும் குழந்தைகளில் மக்னீசியம் தாது உப்பின் அளவு மற்றும் அதன் பங்களிப்பு தொடர்பான ஆய்வு.

1. எனக்கு தரப்பட்ட ஆராய்ச்சியில் பங்கு பெறுவோர்க்கான தகவல் படிவத்தை முழுவதுமாக படித்து புரிந்து கொண்டேன்.
2. ஆராய்ச்சியின் தன்மை முழுவதுமாகவும், விரிவாகவும் எடுத்துரைக்கப்பட்டது. எனது கேள்விகளுக்கு விடையளிக்கப்பட்டது.
3. ஆய்வாளர் எனது உரிமைகளையும், பொறுப்புகளையும் நன்கு விளக்கினார்.
4. நான், எனது குழந்தை ஆய்வாளருக்கு முழு ஒத்துழைப்பு கொடுக்கவும், பரிசோதனை செய்து கொள்ளவும் அனுமதிக்கிறேன்.
5. எனது குழந்தை ஆராய்ச்சியில் பங்கேற்பதால் ஏற்படும் சாதக பாதகங்கள் விளக்கப்பட்டன.
6. நான் எப்பொழுது வேண்டுமானாலும் எனது குழந்தையை இந்த ஆராய்ச்சியிலிருந்து விலக்கிக் கொள்ளலாம் என்று எனக்கு எடுத்துரைக்கப்பட்டது. அவ்வாறு விலகிக் கொள்வதால் குழந்தைக்கு

அளிக்கப்படும் சிகிச்சையில் எந்த மாற்றமும் இருக்காது என அறிந்து கொண்டேன்.

7. இந்த ஆய்வில் என் குழந்தையிடமிருந்து பெறப்படும் மருத்துவ தகவலை ஆய்விதழிலிலோ, கருத்தரங்கிலோ வெளியிடுவதில் எனக்கு எந்தவித ஆட்சேபனையும் இல்லை.
8. அவ்வாறு வெளியிடப்படும் போது என் குழந்தை மற்றும் என் அடையாளங்கள் வெளியிடப்பட மாட்டாது என எனக்கு உறுதியளிக்கப்பட்டது.
9. எனக்கு இந்த ஆராய்ச்சி குறித்து எதுவும் சந்தேகம் இருந்தால் உடனே ஆராய்ச்சியாளரைக் கேட்டு தெளிவுபடுத்திக் கொள்ளலாம் என தெரிவிக்கப்பட்டது.
10. இந்த ஒப்புதல் படிவத்தில் கையொப்பமிடுவதின் மூலம் இந்த படிவத்தில் உள்ளவை யாவும் எனக்கு தெளிவாக எடுத்துரைக்கப்பட்டு அதை நான் நன்கு புரிந்துக் கொண்டேன் என தெரிவித்துக் கொள்கிறேன்.

குழந்தையின் பெற்றோர் / பாதுகாவலர்:

பெயர்: கையொப்பம்:

தேதி:

ஆராய்ச்சியாளர்:

பெயர்: கையொப்பம்:

தேதி:

சாட்சி 1

பெயர்: கையொப்பம்:

தேதி:

சாட்சி 2

பெயர்: கையொப்பம்:

தேதி:

S.No	NAME	AGE	SEX	TYPE OF SEIZURES	No. OF EPISODES	DURATION OF SEIZURES	TEMPERATURE on ARRIVAL °F	INTERVAL BETWEEN FEVER ONSET&SEIZURES	DIAGNOSIS	ANTHRAPOMETRY	ANEMIA(YES/NO)	Blood glucose levels on arrival (mg/ dL)	Serum sodium level (mEq/L)	Serum potassium level (mEq/L)	Serum Calcium level total (mg/ dL)	Ionized Serum Calcium (mg/ dL)	SERUM MAGNESIUM LEVELS(mg/dl)	familyhistory			illness associated
									Febrile Seizure (Simple / Complex)									father	mother	siblings	
1	Deepan	7 months	male	GTCS with upward gaze	1	2 minutes	100.8	6 hrs	simple	normal	yes	69	135	3.9	9.8	4	2.12	yes	no	no	ASOM
2	Saniya	7 months	female	Upward gaze	1	5 minutes	102	4th day	complex	normal	yes	95	133	4.4	10.2	4.4	1.94	no	no	no	URI
3	Kevin	7 months	male	Upward gaze	1	2 minutes	101.4	6hrs	simple	normal	yes	95	141	3.9	9.6	4.4	1.89	no	no	no	URI
4	Sanjay	7 months	male	GTCS with upward gaze	3	each 5 minutes	101	6hrs	complex	normal	yes	97	136	4.6	9	4	2.33	no	no	no	URI
5	Monika	8 months	female	Upward gaze	3	each 5 minutes	38.2	48 hrs	complex	severe acute malnutrition	NO	98	136	4.3	9.1	4	2.21	no	no	no	URI
6	Suthish	8 months	male	GTCS with upward gaze	1	2 minutes	101	2hrs	simple	normal	yes	135	137	4.3	8.6	4.4	1.68	no	no	no	AGE
7	Keerthivasan	8months	male	GTCS with upward gaze	3	each 3 minutes	100	6 hrs	complex	normal	yes	115	134	3.4	9.2	4.4	2.04	yes	no	no	URI
8	Harshan	8months	male	GTCS with upward gaze	1	2 minutes	101	72 hrs	complex	normal	yes	117	135	3.5	10	4	1.73	no	no	no	LRI
9	Shashree	9months	female	GTCS with upward gaze	2	each 10 minutes	99.2	10 hrs	complex	normal	yes	87	136	5.2	9.2	4.4	2.04	no	no	no	URI
10	Durgashree	9months	female	GTCS with upward gaze	1	5 minutes	98	12 hrs	simple	normal	yes	72	133	4.9	9.7	4	1.87	no	no	no	AGE
11	Praveen kumar	9mnths	male	GTCS with upward gaze	1	5 minutes	99	72 hrs	complex	normal	yes	78	136	4.2	9.4	4.2	1.79	no	no	no	URI
12	Imaiyaal	10months	female	Upward gaze	1	10 minutes	101	12hrs	simple	normal	yes	58	135	3.8	9.7	4.2	2.49	no	no	no	LRI
13	Sowjith	10months	male	GTCS with upward gaze	1	2 minutes	104	6hrs	simple	normal	yes	102	135	4.7	10.2	4.4	2.11	no	no	no	No foci
14	Maheshwari	10months	female	GTCS with upward gaze	1	2 minutes	100.4	12hrs	simple	normal	yes	65	132	4.2	9.9	4.4	2.04	no	no	no	No foci
15	Karan	10 months	male	GTCS with upward gaze	1	5 minutes	100	2hrs	simple	normal	yes	132	135	4.9	10.6	4.8	2.06	no	no	no	LRI
16	Yogashree	10months	female	GTCS with upward gaze	1	10 minutes	101.4	7 hrs	simple	normal	NO	83	137	4.4	10.4	4.8	2.31	no	no	no	URI

17	Jeeva adithya	10 months	male	GTCS with upward gaze	1	5 minutes	101.2	6 hrs	simple	normal	yes	130	133	4.6	11.7	4.4	2.2	no	no	no	AGE
18	Ruthresh	11 months	male	GTCS with upward gaze	1	5 minutes	102	6hrs	Simple	normal	yes	102	134	4.2	9.4	4.2	1.87	no	no	yes	URI
19	Rejina begam	11months	female	GTCS with upward gaze	1	5 minutes	102	5hrs	Simple	normal	yes	130	134	4.2	9	4	1.92	no	no	no	URI
20	Sanjana	11months	female	GTCS with upward gaze	1	2 minutes	99.6	6hrs	simple	normal	yes	93	135	4	9.9	4.2	1.6	no	no	no	URI
21	Yuvadharsan	1yr	male	GTCS with upward gaze	2	each 3 minutes	104	1hr	complex	moderate acute malnutrition	yes	115	137	4.5	10.5	4.2	2.42	no	yes	no	No foci
22	Rithik	1 yr	male	GTCS with upward gaze	2	each 5 minutes	103	6hrs	complex	normal	yes	110	134	4	9.6	4.2	2.45	no	no	no	ASOM
23	Mahesh	1yr	male	Upward gaze	1	5 minutes	100	6hrs	Simple	moderate acute malnutrition	NO	96	134	3.8	9.2	4.2	1.24	no	no	yes	URI
24	Kaviyaselvan	1 yr	male	GTCS with upward gaze	2	each 3 minutes	100.6	4 hrs	complex	normal	yes	102	136	4.2	10	4.4	1.58	no	no	yes	No foci
25	Mohamood malik	1 yr	male	GTCS with upward gaze	1	5 minutes	102	8hrs	simple	normal	yes	116	136	4.2	10.2	4.8	2.14	no	no	no	LRI
26	Ravi raj	1yr	male	GTCS with upward gaze	1	5 minutes	100	6hrs	simple	normal	NO	87	137	4.5	9.3	4.8	2.02	no	no	no	URI
27	Rakhsan	1 yr	male	GTCS with upward gaze	1	5 minutes	100	20hrs	simple	normal	yes	126	142	4.6	9.4	4.2	2.2	no	no	no	LRI
28	Dharsan	1 yr	male	Upward gaze	1	2 minutes	101.4	8 hrs	simple	normal	yes	77	136	4.1	8.8	4.2	1.97	no	no	no	URI
29	Nabisha	1yr1month	female	GTCS	1	5 minutes	101	12hrs	simple	normal	yes	76	137	4.9	9.4	4.4	2.04	no	no	no	UTI
30	Joswa	1yr2months	male	Upward gaze	1	10 minutes	101.2	13 hrs	simple	normal	NO	76	138	4.1	9.4	4	2.56	no	no	no	URI
31	Saidharsan	1yr2months	male	Upward gaze	1	5 minutes	100.6	12hrs	simple	normal	yes	72	131	4.1	8.6	4.4	1.96	no	no	no	UTI
32	Sithes	1yr3m	male	GTCS with upward gaze	1	2 minutes	101.4	6hrs	simple	normal	yes	72	135	3.5	7.5	4.4	2.23	no	no	no	URI
33	Bhuvan raj	1yr3m	male	GTCS with upward gaze	1	15 minutes	100	2hrs	simple	normal	yes	78	138	4	8.8	4.4	2.12	no	no	no	No foci
34	Nirmal	1 yr 4m	male	GTCS with upward gaze	1	10 minutes	101	7hrs	simple	normal	yes	86	138	4.4	9.2	4.2	1.99	no	yes	no	AGE
35	Sruthi	1yrs4m	female	GTCS	1	10 minutes	36.7	12 hrs	simple	normal	yes	98	134	4.2	9.4	4.2	2.26	no	no	no	URI
36	Jeevesh	1yr4months	male	GTCS with upward gaze	3	each 2 minutes	101	12hrs	complex	normal	yes	106	138	3.6	9.3	4	1.81	no	no	yes	LRI
37	Gugan	1yr5months	male	GTCS with upward gaze	1	4 minutes	101.2	8hrs	simple	normal	NO	86	134	4.4	10.5	4	2.04	no	no	no	URI

38	Kodeswari	1yr6months	female	Upward gaze	1	3 minutes	101.2	5 hrs	simple	normal	NO	78	131	4.2	9.7	4.5	2.02	no	no	no	UTI
39	Rithika	1yr6m	female	GTCS with upward gaze	1	5 minutes	102	13hrs	simple	normal	yes	78	136	4.6	9	4	2.12	no	no	no	URI
40	Raahul	1yr6 months	male	GTCS with upward gaze	1	3 minutes	102	6hrs	simple	normal	NO	96	136	4.2	9	4.2	2.07	no	no	no	AGE
41	Sarvesh	1yr6 months	male	Upward gaze	1	10 minutes	99	8 hrs	simple	normal	yes	82	136	4.4	10	4.4	1.68	no	no	no	URI
42	Nethra	1yr6m	female	GTCS with upward gaze	1	5 minutes	100.4	8hrs	simple	normal	NO	82	133	4.1	10.2	4.2	1.79	no	no	no	LRI
43	Gowtham	1yr6m	male	GTCS	1	15 minutes	99	11 hrs	simple	severe acute malnutrition	yes	76	135	4.6	9.9	4.2	1.96	no	no	no	URI
44	Keerthika	1yr6m	female	GTCS with upward gaze	1	3 minutes	99.8	4hrs	simple	moderate acute malnutrition	yes	72	131	3.8	9.2	4.1	1.97	no	no	no	URI
45	Priya	1yr6m	female	GTCS with upward gaze	2	each 5 minutes	100.6	2hrs	complex	moderate acute malnutrition	yes	80	141	4.3	8.8	4.8	2.23	no	no	no	AGE
46	Jai rithis	1yr6m	male	GTCS with upward gaze	1	2 minutes	99.8	12hrs	simple febrile seizures	moderate acute malnutrition	yes	74	136	3.4	8.4	4.2	2.44	no	no	no	LRI
47	Raja salmon	1yr6m	male	Upward gaze	1	5 minutes	101	6hrs	simple	moderate acute malnutrition	yes	72	137	3.8	9.7	4	2.17	no	no	no	URI
48	Kevin jai	1yr6m	male	GTCS with upward gaze	1	5 minutes	101	12hrs	simple	moderate acute malnutrition	yes	84	136	4.2	9.2	4.1	2.25	no	no	no	URI
49	Laurance	1yr6m	male	GTCS	1	1minute	102	12hrs	simple	moderate acute malnutrition	yes	102	133	3.9	10	4.4	2	no	no	no	AGE
50	Dhanush	1yr6m	male	GTCS with upward gaze	1	10 minutes	98.4	8 hrs	simple	severe acute malnutrition	yes	78	136	4.2	10.4	4.1	1.72	no	no	no	URI
51	Reshmi	1yr6m	female	GTCS with upward gaze	3	each 5 minutes	100.6	24hrs	complex	normal	yes	86	137	4.6	10.2	4.1	1.68	no	no	no	LRI
52	Jeevitha	1yr6m	female	GTCS with upward gaze	1	10 minutes	103	24hrs	simple	normal	yes	84	135	4.3	9.6	4.2	2.39	no	no	no	URI
53	Harsith	1yr6m	male	GTCS with upward gaze	1	5 minutes	100.4	24hrs	simple	normal	yes	90	135	3.5	9.6	4.1	2.18	no	no	no	URI
54	Alirisha	1yr6m	female	Upward gaze	1	15 minutes	101.2	24 hrs	simple	normal	yes	86	136	4.4	9	4.2	2.21	no	no	no	AGE
55	Harish	1yr7m	male	GTCS	4	each 3 minutes	98.2	24hrs	complex	normal	yes	88	133	4.8	9	4	2.44	no	no	no	URI
56	Keerthika	1yr9months	female	GTCS with upward gaze	1	5 minutes	100	6 hrs	simple	normal	yes	78	135	4.2	10.2	4.1	2.07	no	no	no	LRI

57	Priyadharsini	1yr9months	female	Upward gaze	1	2 minutes	99.2	11 hrs	simple	normal	yes	92	135	4.9	10	4.4	2.1	no	no	no	URI
58	Harimoorthy	1yr9m	male	GTCS with upward gaze	1	1 minute	101.4	16 hrs	simple	normal	yes	72	134	4.1	10.2	4.4	1.77	no	no	no	No foci
59	Abishek	2yrs	male	GTCS	1	10 minutes	101.2	12hrs	simple	normal	yes	106	136	4.2	9.8	4.1	2.03	no	no	no	URI
60	Karmegam	2yrs	male	GTCS with upward gaze	1	2 minutes	99	6 hrs	simple	moderate acute malnutrition	yes	76	137	5	9	4.1	1.88	no	no	no	LRI
61	Vijas	2yr	male	GTCS	1	5 minutes	101.2	8hrs	simple	normal	yes	88	135	3.6	9	4	1.84	no	no	no	URI
62	yaalini	2yrs	female	GTCS with upward gaze	1	1 minute	102.4	12hrs	simple	normal	yes	88	134	3.7	9.5	4.2	1.8	no	no	no	URI
63	Myrthika	2yrs	female	GTCS with upward gaze	1	5 minutes	101.2	6 hrs	simple	normal	NO	76	136	4.2	10.2	4.5	2.29	no	no	no	No foci
64	Laksha	2yrs	female	GTCS with upward gaze	1	3 minutes	100.6	6 hrs	simple	normal	yes	84	136	4.9	8.6	4.1	1.69	no	no	no	URI
65	Muthukumar	2 yrs	male	Upward gaze	1	3 minutes	101	18 hrs	simple	moderate acute malnutrition	yes	98	138	4.7	9.1	4.4	2.62	no	no	no	LRI
66	Manika vasagam	2 yrs	male	GTCS with upward gaze	1	2 minutes	101	14 hrs	simple	normal	yes	102	137	4.9	9.5	4.2	1.42	no	no	no	URI
67	Josika	2yrs	female	GTCS	1	3 minutes	101.2	12 hrs	simple	normal	NO	78	139	4.6	9.5	4.2	2.14	no	no	no	URI
68	Sooraj	2 yrs	male	GTCS with upward gaze	1	2 minutes	99	8hrs	simple	normal	yes	78	134	4.4	9.8	4.2	2.1	no	no	no	AGE
69	Alen	2 yrs	male	GTCS with upward gaze	1	10 minutes	101	8hrs	simple	normal	yes	82	138	4.5	10.2	4.5	2.05	no	no	no	No foci
70	Tharnish	2 yrs	male	Upward gaze	1	5 minutes	100.8	6 hrs	simple	normal	NO	98	133	4.3	8.9	4	2.78	no	no	no	URI
71	Prateheeswaran	2 yrs	male	GTCS with upward gaze	1	2 minutes	100.8	6 hrs	simple	normal	yes	104	136	3.9	9.2	4.2	1.79	no	no	no	AGE
72	Miruthilesh	2yr	male	GTCS with upward gaze	1	20 minutes	101.3	6 hrs	complex	normal	yes	88	143	5	9.3	4.1	1.89	no	no	yes	URI
73	Riyashree	2yr	female	GTCS with upward gaze	5	each 5 minutes	101.3	5 hrs	complex	normal	yes	86	133	5.1	9.9	4	2.23	no	no	no	No foci
74	Hariharan	2yrs6months	male	GTCS with upward gaze	1	5 minutes	100.8	8 hrs	simple	normal	yes	98	141	3.7	8.6	4.2	2.48	no	no	no	UTI
75	Gomathy	2yr6m	female	Upward gaze	1	3 minutes	102.8	5hrs 30mins	simple	normal	NO	88	135	4.1	9.9	4.2	2.15	no	no	no	URI
76	Magadheera	2yrs8months	male	GTCS	1	3 minutes	100.8	8 hrs	simple	normal	yes	92	135	4.4	8.7	4	2.02	no	no	no	URI
77	Krithik	2 yrs9m	male	GTCS with upward gaze	2	each 10 minutes	100.4	6 hrs	complex	moderate acute malnutrition	yes	98	136	5	10.2	4.2	2.06	no	no	no	No foci

78	Varalaxmi	3yrs	female	upward gaze	1	3 minutes	102	12hrs	simple	normal	yes	96	138	4.2	9.4	4.1	1.9	no	no	no	URI
79	Vetrimaran	3yrs	male	GTCS	1	10 minutes	100.6	12hrs	simple	normal	NO	82	136	4.4	9	4.1	1.88	no	no	no	AGE
80	Tamil selvan	3yrs	male	GTCS with upward gaze	1	3 minutes	103.4	6hrs	simple	normal	yes	82	136	4.6	10	4.1	2.88	no	no	no	URI
81	Sanjay	3yrs	male	GTCS	1	5 minutes	101.2	1 hr	simple	normal	NO	76	138	4.3	10.2	4.1	2.62	no	no	no	URI
82	Mithreyan	3 yrs	male	GTCS with upward gaze	1	10 minutes	101	6 hrs	simple	normal	yes	82	136	4.2	10.2	4.4	1.56	no	no	no	No foci
83	Divayadharsini	3 yrs	female	GTCS with upward gaze	1	3 minutes	100.6	3 hrs	simple	normal	NO	126	138	4.2	10.2	4.8	1.84	no	no	no	URI
84	Divyashree	3 yrs	female	GTCS with upward gaze	1	5 minutes	101.2	5 hrs	simple	normal	yes	74	136	3.8	8.9	4.2	1.83	no	no	no	URI
85	Kaniska	3 yrs	female	Upward gaze	1	15 minutes	102.4	36 hrs	complex	normal	yes	117	135	3.6	9	4.2	2.14	no	no	no	URI
86	Sadhanashree	3 yrs	female	GTCS with upward gaze	3	each 5 minutes	101.4	36 hrs	complex	normal	yes	96	136	4.2	9.2	4.2	1.89	no	no	no	No foci
87	Vignesh	3yrs6month	male	GTCS	1	2 minutes	100.2	2 hrs	simple	normal	yes	78	135	4.4	9	4.2	1.67	no	no	no	URI
88	Niveth	3yrm9m	male	GTCS with upward gaze	1	5 minutes	101	6hrs	simple	normal	yes	68	137	4.1	10.6	4.5	2.45	no	no	no	No foci
89	Hemavardhini	4yrs	female	Upward gaze	1	5 minutes	101.6	2 hrs	simple	normal	yes	86	136	4.2	9.8	4.4	2.5	no	no	no	AGE
90	Siddharth	4 yrs	male	GTCS with upward gaze	1	15 minutes	101	3 hrs	complex	severe acute malnutrition	yes	82	138	4.2	9.2	4.1	2.14	no	no	no	URI
91	Anith	4yrs	male	GTCS	2	each 5minutes	102.2	4 hrs	complex	normal	NO	78	136	4.2	9.2	4.1	1.87	no	no	no	URI
92	Velvizhi	4yrs6m	female	GTCS with upward gaze	1	5 minutes	101.2	12 hrs	simple	severe acute malnutrition	NO	82	138	4.4	9	4.3	2.03	no	no	no	URI
93	Umarkaan	4yrs6m	male	Upward gaze	1	10 minutes	101	4th day	complex	normal	yes	88	138	4.2	9	4.4	1.99	no	no	no	No foci
94	Sasmitha	4yr6m	female	GTCS	1	10 minutes	101.2	12hrs	simple	normal	yes	102	138	4.5	8.8	4.2	2.13	no	no	no	URI
95	Brindhashree	5yrs	female	GTCS with upward gaze	1	2 minutes	101.4	6 hrs	simple	normal	yes	82	140	4.2	8.8	4.2	1.86	no	no	no	URI
96	Saravanan	5 yrs	male	Upward gaze	1	5 minutes	101.4	13 hrs	simple	normal	NO	90	138	4.1	9.2	4.5	1.46	no	no	no	URI
97	Nithesh	5 yrs	male	GTCS with upward gaze	1	10 minutes	102	7hrs	simple	normal	NO	88	139	4.2	10.2	4.2	1.55	no	no	no	No foci
98	Saaral	5yrs	female	Upward gaze	1	10 minutes	103	12hrs	simple	normal	yes	76	137	4.1	9	4.1	1.64	no	no	no	URI
99	Monisha	5yrs	female	GTCS with upward gaze	1	1 minute	100.6	36 hrs	complex	normal	NO	82	134	4.3	10	4.5	1.87	no	no	no	No foci
100	Gokul	5yrs	male	GTCS	1	10 minutes	100.2	6hrs	simple	moderate acute malnutrition	yes	94	136	4.4	9.2	4.2	2.31	no	no	no	URI

.NO	NAME	AGE	SEX	ANTHRAPO METRY	ANEMIA(YES/NO)	Blood glucose levels on arrival	Serum sodium level (mEq/L)	Serum potassium level (mEq/L)	Serum Calcium level total (mg/	Ionized Serum Calcium (mg/	SERUM MAGNESIUM LEVELS(mg/dl)	FAMILY HISTORY			illness associated
												FATHER	MOTHER	SIBLING	
1	Mohith kumar	7 months	male	Normal	yes	72	138	4.5	9.2	4.1	1.77	no	No	no	UTI
2	Yeswee	7 months	female	Normal	no	112	140	4.1	9.2	4.4	2.14	no	No	no	ASOM
3	Rithis sairam	7 months	male	Normal	yes	88	134	4.2	9	4.5	1.77	no	No	no	UTI
4	Yogesh	7 months	male	Normal	yes	82	135	4.2	9	4.4	1.45	no	No	no	Pneumonia
5	Haritha	8 months	female	Normal	yes	86	135	4	9.2	4.3	2.3	no	No	no	LRI
6	Harprit	8 months	male	severe acute malnutrition	yes	70	138	4.2	9.4	4.2	2.12	no	No	no	LRI
7	Monish	8months	male	Normal	no	92	136	4.2	10.2	4.2	1.93	no	No	no	URI
8	Vasanth	8months	male	moderate acute malnutrition	no	84	136	4.2	9.4	4.2	2.2	no	No	no	UTI
9	Sanjana	9months	female	Normal	yes	70	134	4.2	9.8	4.2	1.96	no	No	no	Pneumonia
10	Keerthika	9months	female	moderate acute malnutrition	yes	86	136	4.2	9.4	4.2	2.01	no	No	no	LRI
11	Araathan	9mnths	male	Normal	yes	106	134	4.2	9.2	4.1	1.82	no	No	no	URI
12	Manimozhi	10months	female	Normal	yes	98	134	4.4	9.4	4.1	1.86	no	No	no	ASOM
13	Kavin	10months	male	Normal	no	86	136	4.2	9	4	1.98	no	No	no	Pneumonia
14	Yaalini	10months	female	Normal	no	98	138	4.2	9.4	4.1	2.23	no	No	no	URI
15	Gowtham	10 months	male	moderate acute malnutrition	yes	78	136	4.2	9.2	4	1.77	no	No	no	LRI
16	Naagini	10months	female	moderate acute malnutrition	yes	86	142	4.2	9.4	4.1	1.9	no	No	no	Pneumonia
17	Monish	10 months	male	Normal	no	72	138	4.2	9.2	4	1.93	no	No	no	LRI

18	Nandavel	11 months	male	Normal	no	82	136	4.2	10.2	4.4	2.12	no	No	no	No foci
19	Ribath nasha	11months	female	moderate acute malnutrition	yes	76	137	4.2	9.4	4.1	2.07	no	No	no	Pneumonia
20	Keerthana	11months	female	severe acute malnutrition	yes	78	138	4.5	9	4.1	1.92	no	No	no	No foci
21	Subash	1yr	male	Normal	yes	80	136	4.4	8.9	4.1	2.88	no	No	no	UTI
22	lavakusha	1 yr	male	moderate acute malnutrition	yes	88	138	4.3	9.4	4.2	1.67	no	No	no	LRI
23	Sarweshwaran	1yr	male	Normal	yes	72	140	4.5	10	4.5	2.28	no	No	no	Pneumonia
24	Ruthwik	1 yr	male	severe acute malnutrition	yes	86	138	4.5	9	4	2.84	no	No	no	LRI
25	Risanth	1 yr	male	Normal	yes	96	135	4.3	9.4	4.2	2.05	no	No	no	LRI
26	Rohith	1yr	male	Normal	no	102	140	4.4	10	4.5	2.24	no	No	no	UTI
27	Idhayan	1 yr	male	Normal	yes	110	138	4.2	9.6	4.2	1.84	no	No	no	No foci
28	Tanish	1 yr	male	Normal	no	108	139	4.4	9.8	4.4	1.85	no	No	no	LRI
29	Mathumitha	1yr1month	female	moderate acute malnutrition	yes	88	138	4.3	9	4.1	1.87	no	No	no	No foci
30	Vijaya kumar	1yr2months	male	moderate acute malnutrition	no	108	142	4.4	9.4	4.2	1.82	no	No	no	Pneumonia
31	Nandha	1yr2months	male	Normal	no	78	136	4.4	9.2	4.5	1.87	no	No	no	No foci
32	Prathap	1yr3m	male	Normal	no	96	138	4.1	9.1	4.2	2.18	no	No	no	Pneumonia
33	Kishore	1yr3m	male	moderate acute malnutrition	yes	94	134	4.2	9.2	4	1.83	no	No	no	URI
34	Joswa	1 yr 4m	male	Normal	no	84	139	4.8	9	4.2	1.73	no	No	no	LRI
35	Bhavani	1yrs4m	female	Normal	no	86	142	4.2	9	4.1	2.11	no	No	no	No foci
36	Jana	1yr4months	male	moderate acute malnutrition	yes	76	139	4.2	10	4.5	1.98	no	No	no	URI
37	Harish kumar	1yr5months	male	Normal	yes	100	139	4.2	10	4.4	1.92	no	No	no	Pneumonia
38	Anuska	1yr6months	female	moderate acute malnutrition	no	78	144	4.4	10	4.5	2.11	no	No	no	AGE
39	Jothi	1yr6m	female	Normal	no	76	136	4.2	9.4	4.2	2.12	no	No	no	Pneumonia
40	Sankar sai	1 yr6 months	male	moderate acute malnutrition	no	86	135	3.8	9.2	4.1	1.93	no	No	no	AGE

41	Prathees	1 yr6 months	male	Normal	no	94	136	3.9	9	4	1.84	no	No	no	LRI
42	Yuvathi	1yr6m	female	Normal	yes	96	138	4.1	8.9	4	1.76	no	No	no	No foci
43	Sriman	1yr6m	male	Normal	no	100	139	4.2	9.6	4.2	2.14	no	No	no	AGE
44	Laksitha	1yr6m	female	moderate acute malnutrition	yes	98	142	4.8	10	4.5	2.08	no	No	no	LRI
45	Swathi	1yr6m	female	Normal	no	78	138	4.6	9.8	4.3	1.96	no	No	no	LRI
46	Rithissaran	1yr6m	male	Normal	no	72	136	4.5	9.2	4	1.88	no	No	no	Pneumonia
47	Mahesh	1yr6m	male	moderate acute malnutrition	yes	68	140	3.8	9.1	4.1	1.86	no	No	no	AGE
48	Vasanth	1yr6m	male	Normal	yes	86	141	3.9	9	4	2.02	no	No	no	No foci
49	Premkumar	1yr6m	male	Normal	no	88	142	4	9.2	4.1	1.87	no	No	no	UTI
50	saisiva	1yr6m	male	moderate acute malnutrition	yes	94	136	4	9.4	4.2	1.76	no	No	no	No foci
51	Deeksitha	1yr6m	female	Normal	no	80	138	4.1	9.6	4.1	1.88	no	No	no	URI
52	Varshini	1yr6m	female	Normal	no	96	140	4.2	10	4.4	2.06	no	No	no	LRI
53	Ragavan	1yr6m	male	Normal	yes	100	141	4.6	9	4	1.86	no	No	no	AGE
54	Dhansika	1yr6m	female	moderate acute malnutrition	yes	102	136	4.8	10	4.5	1.85	no	No	no	LRI
55	Anish	1yr7m	male	Normal	no	88	135	5	9.2	4.1	2	no	No	no	No foci
56	Swathi	1yr9months	female	Normal	no	72	140	4	8.9	4	1.86	no	No	no	AGE
57	Thamanna	1yr9months	female	Normal	yes	74	142	4.2	9.4	4.1	1.98	no	No	no	URI
58	Varun	1yr9m	male	moderate acute malnutrition	yes	76	144	4.4	9.1	4.2	2.06	no	No	no	LRI
59	Karthikeyan	2yrs	male	moderate acute malnutrition	yes	110	145	4.2	9.2	4.2	2.1	no	No	no	URI
60	Thravidan	2yrs	male	Normal	no	108	140	4.2	10	4.3	1.22	no	No	no	LRI
61	Karthi	2yr	male	Normal	no	104	138	4.3	10	4.4	2.24	no	No	no	LRI
62	Nithyan	2yrs	female	moderate acute malnutrition	yes	82	136	4	9.6	4	1.95	no	No	no	Pneumonia
63	Riyan	2yrs	male	moderate acute malnutrition	yes	94	140	3.8	9.2	4.1	1.48	no	No	no	AGE

64	Chinazeer	2yrs	female	moderate acute malnutrition	yes	76	136	4	9.1	4	1.93	no	No	no	URI
65	Kumaravel	2 yrs	male	moderate acute malnutrition	yes	78	138	4	8.8	4	1.92	no	No	no	LRI
66	Thasik	2 yrs	male	Normal	no	84	136	3.8	9.4	4	2.01	no	No	no	No foci
67	Pravasthi	2yrs	female	Normal	no	90	136	3.6	9	4.1	1.78	no	No	no	AGE
68	Harish kumar	2 yrs	male	moderate acute malnutrition	yes	92	137	4.6	9	4.1	2.05	no	No	no	No foci
69	Venkatesan	2 yrs	male	Normal	no	96	139	4.8	9.2	4.2	1.95	no	No	no	No foci
70	Mahilan	2 yrs	male	Normal	no	84	140	4	10	4.4	2.34	no	No	no	URI
71	Tamil iniyan	2 yrs	male	Normal	no	68	138	4	9.8	4.3	2.16	no	No	no	AGE
72	Amudhan	2yr	male	Normal	no	78	138	4.5	9.4	4.1	2.12	no	No	no	AGE
73	Harini	2yr	female	severe acute malnutrition	yes	90	140	4.6	9.6	4.2	1.83	no	No	no	LRI
74	Sreevarshan	2yrs6months	male	Normal	yes	88	136	4.6	10	4.5	1.71	no	No	no	URI
75	Boomika	2yr6m	female	Normal	no	84	135	3.8	10	4.4	1.87	no	No	no	AGE
76	Yuvan	2yrs8months	male	Normal	yes	72	136	3.7	9.6	4.2	2.14	no	No	no	No foci
77	Priyadharshan	2 yrs9m	male	moderate acute malnutrition	yes	68	138	3.6	8.8	4	1.93	no	No	no	LRI
78	Bavya	3yrs	female	Normal	yes	72	140	4	9.4	4.1	1.43	no	No	no	AGE
79	Kaaviyan	3yrs	male	Normal	no	76	136	4.2	9.2	4	1.68	no	No	no	No foci
80	Lithis	3yrs	male	moderate acute malnutrition	yes	80	135	4.4	9.1	4	1.97	no	No	no	AGE
81	Velavan	3yrs	male	Normal	yes	70	140	4.5	10	4.4	2.24	no	No	no	URI
82	Mahilan	3 yrs	male	Normal	no	96	142	4	9.4	4.2	2.14	no	No	no	No foci
83	Ramya	3 yrs	female	Normal	yes	98	141	4	10	4.5	1.64	no	No	no	AGE
84	Yuvanthika	3 yrs	female	Normal	no	102	136	4.2	8.9	4	1.93	no	No	no	LRI
85	Sathana	3 yrs	female	Normal	no	76	136	3.8	9.2	4.1	1.77	no	No	no	LRI
86	Abiyan	3 yrs	female	Normal	yes	90	138	3.7	9.6	4.2	1.84	no	No	no	No foci

87	Vishnuvardhan	3yrs6month	male	Normal	no	78	140	3.6	9.4	4.2	1.95	no	No	no	LRI
88	Kannivalavan	3yrm9m	male	Normal	yes	72	142	3.5	9.1	4.1	2.16	no	No	no	AGE
89	Hasini	4yrs	female	moderate acute malnutrition	no	74	141	3.8	9.2	4	1.95	no	No	no	LRI
90	Manoj	4 yrs	male	Normal	no	88	136	3.6	10	4.5	2.06	no	No	no	No foci
91	Veera sakthi	4yrs	male	Normal	yes	84	137	4.2	9.4	4.1	1.88	no	No	no	LRI
92	Lithika	4yrs6m	female	moderate acute malnutrition	yes	96	138	4.4	10.2	4.5	2.14	no	No	no	No foci
93	Varun prasad	4yrs6m	male	Normal	no	94	137	4.1	10	4.4	2.12	no	No	no	AGE
94	Devan	4yr6m	female	Normal	no	106	137	3.8	9	4	2.16	no	No	no	No foci
95	Janani	5yrs	female	Normal	yes	98	136	4	9	4.1	2.24	no	No	no	No foci
96	Bhuvanesh	5 yrs	male	Normal	yes	76	140	4.1	9.4	4.2	2.24	no	No	no	AGE
97	Saran	5 yrs	male	Normal	yes	68	141	3.8	9.2	4.1	1.86	no	No	no	LRI
98	Bhavana	5yrs	female	Normal	yes	70	138	3.9	9.6	4.3	2.14	no	No	no	LRI
99	Sruthi	5yrs	female	Normal	yes	80	136	4	9	4	2.15	no	No	no	No foci
100	Bramma devan	5yrs	male	moderate acute malnutrition	yes	92	135	4.2	10	4.5	2.04	no	No	no	AGE