"A Comparative Study on Developmental Screening in Children by using INCLEN – neuro developmental screening tool and ICMR - psychosocial screening tool"

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DISSERTATION SUBMITTED TO THE SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, KOLAR, KARNATAKA

In partial fulfilment of the requirements for the degree of

DOCTOR OF MEDICINE

IN

PEDIATRICS

Under the guidance of

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"A comparative study on developmental screening in children by using INCLEN - neurodevelopmental screening tool and ICMR- psychosocial screening tool"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. K N V Prasad,** Department of Pediatrics, SDUMC, Kolar.

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ACKNOWLEDGEMENT

No academic work is single handedly accomplished. This work is no exception. Words fail me in expressing my heartfelt and humble gratitude to my guide

DR KNV PRASAD, *M.D., Professor & HOD, Department of Pediatrics, for the guidance and encouragement all along in completing my study. His encouragement, sense of punctuality, research oriented approach, the painstaking effort to weed out errors and his affection during the entire course of study leaves me permanently indebted to him.*

I express my deep sense of gratitude and humble thanks to my senior professor/associate professors, Dr.Beeregowda YC, Dr.Krishnappa J, Dr SudhaReddy.V.R , Dr.Bhanuchand P, Dr.Shivaraja for their advice and encouragement throughout the study.

I am very thankful to my friends Dr Shruti, Dr Kusuma, Dr Nitish, Dr Samarth, Dr Varsha, Dr Nivetha and Dr. Pavan for all their constant help and support.

I am very much thankful to my parents, my dear husband and all the family members for their love and blessings. Last, but not the least, I thank the Almighty and my patients for providing me the opportunity to carry out my study.

Dr. RANI K N

ABBREVIATIONS

1. **ICMR- tool: Indian Council of Medical Research psychosocial developmental screening tool**
2. **INCLEN – tool: International Clinical and Epidemiology Network- neurodevelopmental screening tool**
3. **CP- Cerebral Palsy**
4. **NMI: Neuro Motor Impairments**
5. **NMD: Neuro Muscular Disorders**
6. **AAP: American Academy of Paediatrics**
7. **WHO: World Health Organisation**
8. **CNS: Central Nervous System**
9. **UNICEF: The United Nations Children's Fund**
10. **Cr: Crore**
11. **IAP: Indian Academy of Pediatrics**
12. **DQ: Developmental Quotient**
13. **NDD: Neuro Developmental disorders**
14. **DDST II: Denver Developmental Screening Test**
15. **BINS: Bayley Infant Neurodevelopmental Screener**
16. **PEDS: Parents' Evaluations of Developmental Status**
17. **ASQ: Ages and Stages Questionnaires**
18. **BDST: Baroda Developmental Screening Test**
19. **TDSC: Trivandrum Developmental Screening Test**
20. **WHO- MGRS: World Health Organisation- Multicentre Growth Reference Study**
21. **SD: Standard deviation**

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ABSTRACT

INTRODUCTION AND BACKGROUND:

It is estimated that 200 million children under 5 years worldwide are not fulfilling their potential for growth, cognition, or socio-emotional development. During the first five years of life, children lay the groundwork for lifelong development. Thus, it is critical to assess children during this vulnerable period in order to determine if they are developing appropriately, and to plan interventions if the children are not developing optimally.

Study design:

A cross sectional, comparative study.

OBJECTIVES OF THE STUDY:

1. To assess development using ICMR (Indian Council Of Medical Research)-psychosocial developmental screening tool.
2. To assess development using INCLEN (International Clinical and Epidemiology Network) – neuro-developmental screening tool.
3. To compare the outcome of two developmental screening tools.

METHOD OF COLLECTION OF DATA

Study population: Children aged 2-6 years attending anganwadicenter's in Kolar town.

Inclusion Criteria:1. Children aged 2-6 years was included in the study after taking consent of parents or guardian or teacher.

Exclusion Criteria:1. Children with diagnosed neurodevelopment impairment or disability.

2. Children with acute illness.

Screening tool:1. ICMR – psychosocial developmental assessment screening tool.

Assessor: Parents/Guardians.

Screening tool:2. INCLEN – a newer tool

Assessor: Section -1 by parents/guardians

Section-2 and 3 by Paediatric post graduate

SAMPLING SIZE AND STATISTICAL ANALYSIS:

A sample size of 234 children was calculated.

All available children in anganwadi was included so that the standards which will be found would not be skewed towards any particular group.

Descriptive data was analysed by calculating percentages. Outcomes of developmental assessment were analysed using Chi-Square test.

The comparison between INCLEN and ICMR tool was done by calculating psychometric parameters [sensitivity, specificity, positive and negative predictive values].

RESULTS: Out of 234 children, 3.4% - 8% of children had delay in development using ICMR tool. By INCLEN tool, 18% of children had delay in development. Among children with NMI (neuromotor impairment), predominant had other NMI(7.3%) and INDETERMINATE(5.6%) results. On comparison of INCLEN a newer tool with ICMR tool which is an existing tool, INCLEN tool found to have **80.95% of sensitivity** and **94.76% of specificity**.

CONCLUSION: INCLEN tool can be adopted to assess development in children aged 2-6 year.

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INTRODUCTION

INTRODUCTION

A child is not a salmon mousse. A disabled child is a stunted version of a larger person, whom you will someday know. Your job is to identify and help them overcome the disabilities associated with their disabilities and inexperience so that they get on with being that larger person.

- Barbara Ehrenreich.

Neurodevelopment is a term referring to the brain's development of neurological pathways that influence performance or functioning (e.g., intellectual functioning, reading ability, social skills, memory, attention or focus skills)[1].

Neurodevelopment begins in-utero, with most of the structural features of the brain formed by the 8th week of conception. Neurodevelopment is reflected by the sequential attainment of various developmental milestones[2]. As a child grows, child learns different skills such as turning head towards the light, taking the first step or waving good bye[2]. These skills are known as developmental milestones, gross motor milestones are shown in figure 1.

Figure 1: Gross motor milestones.

Development is considered delayed when the impediment is **more than two standard deviation below the mean** in one or more of the developmental domains[3]. Routine developmental assessment at each visit to a doctor/health worker and tracking developmental events during early years of life is important to seek medical advice at the earliest and to plan for diagnostic approach and intervention[2].

AAP (American Academy of Paediatrics) recommends developmental screening of high risk children at each visit from birth to 3 years and routine screening of low risk children at 9, 18 and 24/30 months[4].

As we talk about the importance of development and developmental assessment of a child, it's worthwhile to have knowledge about the child population and magnitude of developmental disabilities among the children. India has the second largest child population in the World. A child population numbering over 2.2 billion worldwide and 263.9 million in India[5]. WHO estimates that 15-20% of children worldwide have disabilities, among this 85% are in developing countries[6].

In India, multiple challenges exist to practice universal developmental screening for a child. **For example:**

1. Parents are unaware of the services provided by the government and its importance[7].
2. A diverse population of doctors caters the health needs of Indian children[7].

These challenges to be addressed with proper education to parents and families at community level. Such as, if parents express concerns, often they are given false assurances without a proper guidance, thus there is a need to address theirs query with proper counselling and assessing the child with appropriate developmental screening tool[8].

As a paediatricians, its mandatory to know the tools available for developmental assessment in a child, in order to provide vital information regarding development of a child in high risk cases and for routine screening of a child[2].

In a study of perceptions and practices of 90 paediatricians in Gujarat, reveals that still there is lack of structured tool for screening and evaluation of development of a child by the primary care physicians[9]. Hence there is no unique tool found, which could be useful for all varied range of population and each tool has its own limitations.

In this context and in search of a good screening test, a large multi-centric cross sectional study was conducted by **ICMR** in the year 1991 to screen the children under 6 years of age for developmental disabilities. This study gave us a simple, cost effective psychosocial developmental screening tool which is standardised to use on Indian preschool children[10]. Which is used as a standard developmental screening tool in our study.

Recently, **INCLEN** has conducted a study in urban, rural and hilly areas of India to estimate the prevalence of developmental disorders using INCLEN –

neurodevelopmental screening tool which is validated for use among 2-9 year old children[11]. In our study INCLEN tool was used to screen the children for developmental disabilities in comparison with the ICMR- psychosocial screening tool.

Few studies have been done on children using INCLEN – tool, which states that INCLEN tool has a good sensitivity and specificity values, with advantages of requirement of short duration of training, administration time of 20-25 minutes and no requirement of special equipment to administer the tool[12].

Several comparative studies have been done in past, comparing various developmental screening tools to find an ideal screening tool suitable for children. The results of these studies are unsatisfactory[11].

Hence there is a need to undertake studies on developmental screening tools to search an appropriate, relevant and easily administered tool in primary health care centres to assist in diagnosis, timely referral and early commencement of interventions when possible.

In our study we have screened the children for developmental disabilities using ICMR- tool and INCLEN- tool. Secondly compared two screening tools using acceptable psychometric parameters to fill the lacuna existing in literature in search of a good screening test.

OBJECTIVES

OBJECTIVES OF THE STUDY

1. To screen for developmental delay using ICMR- psychosocial developmental screening tool in study children.
2. To screen for developmental delay using INCLEN- neurodevelopmental screening tool in study children.
3. To compare the developmental delay assessed between INCLEN tool and ICMR tool in study children.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

People with disabilities are vulnerable because of the many barriers we face: attitudinal, physical, and financial. Addressing these barriers is within our reach and we have a moral duty to do so..... But most important, addressing these barriers will unlock the potential of so many people with so much to contribute to the world. Governments everywhere can no longer overlook the hundreds of millions of people with disabilities who are denied access to health, rehabilitation, support, education, and employment—and never get the chance to shine.

- Stephen Hawking.

NEURODEVELOPMENT OF A CHILD

Neurodevelopment of a child begins in-utero[1]. During 3rd week of gestation, a neural plate appears on the ecto-dermal surface of the tri-laminar embryo. In-folding of neural plate produces a neural tube which will be the central nervous system and a neural crest that becomes the peripheral nervous system[2].

By the 5th week, the 3 main division- forebrain, mid brain and hind brain are evident. By the end of 8th week, the gross structures of the nervous system will be developed, migration of nerves completes by 6th month, but differentiation continues[13].

Migration of neurons is a very important and complex process. Synapse formation, which occurs in the last trimester as well as in the first 2 years of life, is essential for functioning and development of a child[2]. Axons and dendrites of nerves form synaptic connection and make the CNS susceptible to teratogens and hypoxic effect which is shown in figure 2.

Physiological differences between children and adults are not only manifest in immature metabolic pathways. Because important systems like CNS will still be differentiating and growing, children will be susceptible to many toxic elements during the critical window period of development[14].

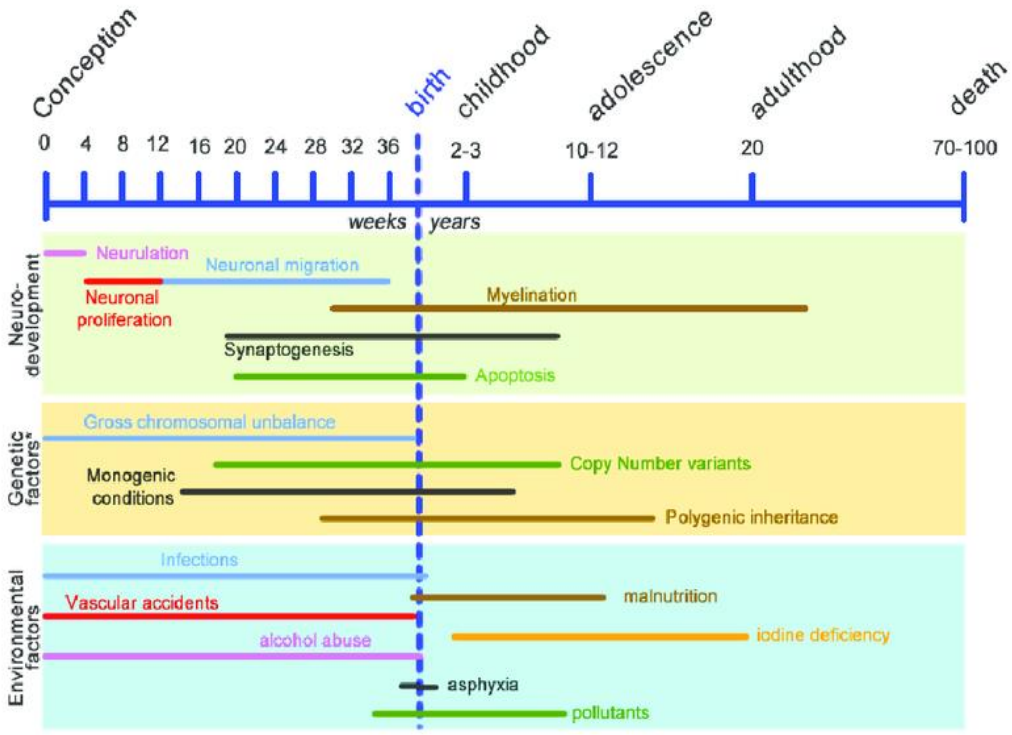


Figure 2: Neurodevelopmental Stages of Brain.

Many developmental delays or disabilities are results of disruption of the functional connectivity of brain networks during migration and differentiation. They may manifest during neonatal period or late in life[14]. Development occurs very quickly as the neurological system matures in the first few years of life [13]. Development of child during early years of life is complex which consists of sequential attainment of developmental milestones. The child during this period of development is vulnerable to many factors such as environment, psychosocial

milieu and emotional stimulation[15]. The critical window period of development is shown in figure 3. The responsibility lies within us to create an appropriate environment which aids in the normal development of children.

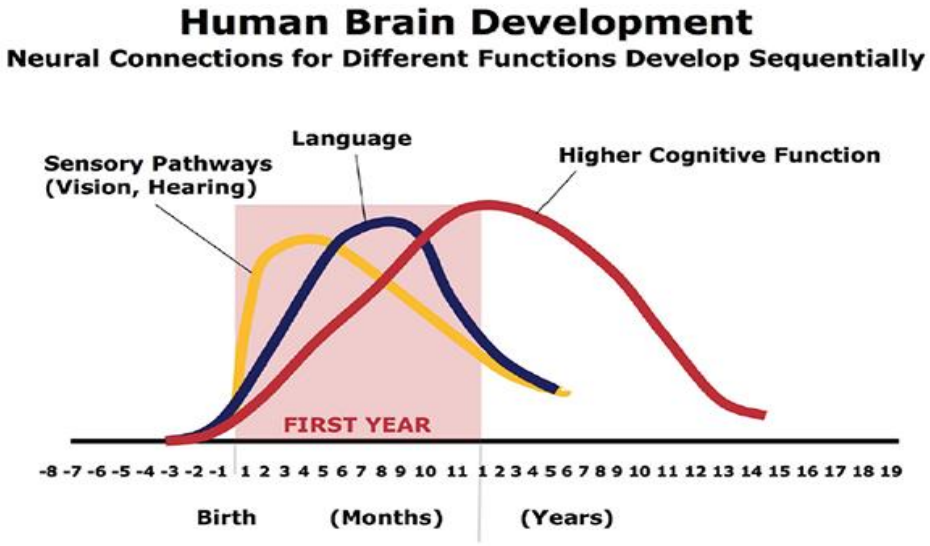


Figure 3: Critical Window Period of Development.

Developmental milestones are divided into major four domains and milestones attained by children aged 2-6 years[16] are shown in table 1.

Age (in years)	Gross motor skills	Fine motor skills	Language skills	Social skills
Two	Can walk downstairs	Draws circle/lines	2 words with phrases	Takesoff clothes .
Three	Pedals tricycle	8 cube tower	3 word sentences	Puts on clothes
Four	Hops on one foot	Copies square	Talks with adjectives	Group play
Five	Skips	Copies a triangle	Reads 25 words	Group of friends
Six	Tandem walk	Draws diamond shape, ties shoes	8-10 word sentences	Same sex best friends

Table 1: Normal Developmental Milestones attained by 2-6 year old children.

WHY TO ASSESS DEVELOPMENT OF A CHILD

As we know the normal sequence of development, responsibility of assessing the development of children attending **well baby clinics** for immunization at regular intervals is with the paediatrician/primary health care physicians[17]. The children attending well baby clinic should be screened for any delay/deviance from the normal development. It is an opportunity to be utilised by every paediatrician to screen and detect the children with developmental disability at the earliest before parental concerns are raised[18].

In this modern era, every **parent is curious** to know about the development of their child. For example: In previous pregnancy if there had been a miscarriage or stillbirth or if the child had proved to be intellectually or physically disabled[19]. It would be natural for parents to be anxious to know whether their new baby is developing normally. A family history of intellectual disability, cerebral palsy or other disability would alleviate their anxiety[18].

Parents should be educated about the **red flag signs** in the developmental sequence of a child[20]. Some of the red flag signs are:

• Not fixing or following an object

• Low muscle tone / floppy or increased muscle tone

• No speech by 18 months

• Persistent toe walking

• Can't sit unsupported by 12 months

• Can't walk by 18 months (male) or 2 years (female)

• Loss of attained developmental skills at any age.

All the effort should be made to use developmental screening tools at the optimal set up. Early identification of children with developmental delay or disabilities allows for **timely referral to tertiary centres**. For appropriate developmental interventions as well as **Diagnostic evaluations** and **Treatment planning[18].**

On identifying developmental disabilities and initiating treatment for the cause, developmental assessment at regular intervals is required **to observe the effect of treatment** of metabolic disorders, exposure to toxic substances, convulsions, meningitis and many conditions that may cause brain damage and even for medico legal purpose[21].

It also has the potential to provide much needed **epidemiological data** on disability statistics for development of policies, strategic planning, identification of key interventions, and service provision by the government to reduce the burden of morbidity and mortality[22]. Let us know about the prevalence of developmental disabilities worldwide and in India.

BURDEN OF DEVELOPMENTAL DISABILITIES IN WORLD AND IN INDIA:

WHO states that, global prevalence of developmental delay in children is reported as **1-3 %** and it estimates that 15% of world's population lives with some form of disability. **86 % of them live in developing countries** compared to 8% in the developed countries[4].

UNICEF estimated that more than 180 million developmental delay occur among under five in developing countries, accounting more than 86% in the world[23].

Globally every year, 180-200 million under five children exhibits developmental delay. The average global prevalence of moderate and severe disability is about 5% in children aged 0-14 years; it is more common among children in the low- and middle income countries[24].

As per Census 2011, in India, out of the 121 Cr population, about 2.68 Cr persons are 'disabled' which is 2.21% of the total population. There are 7,862,921 children with disability in the below 19 years of age. Which includes 1,410,158 of visual impairment, 1,594,249 of hearing impairment, 683,702 of speech disorders, 1,045,656 movement disorders, 595,089 intellectual disability and 1, 719,805 other disabilities[5,25].

Among the disabled population 56% (1.5 Cr) are males and 44% (1.18 Cr) are females. In the total population, the male and female population are 51% and 49%respectively.Majority (69%) of the disabled population resided in rural areas (1.86 Cr disabled persons in rural areas and 0.81 Cr in urban areas)[5,25].

DISABLED CHILD POPULATION IN INDIA – CENSUS 2011

Disabilities among children (0-6 years)

The disability among children is a matter of serious concern as it has wider implications. The Census 2011 showed that, in India, 20.42 lakhs children aged 0-6 years are disabled. Thus, one in every 100 children in the age group 0-6 years suffered from some type of disability[25].

1.24% of the total children (0-6 years) are disabled. The percentage of male disabled children to total male children is 1.29% and the corresponding figure for females is1.19%[25].

The proportion of disabled males to total males is higher than the corresponding proportion for females at all India and at rural and urban areas. The same pattern has been observed in the case of children (0-6) years[25].

The proportion of disabled to the total population for all ages is higher in rural areas for both males and females, while for children, the same is higher in urban areas[25].

The above statistics is depicted in the figure 4.

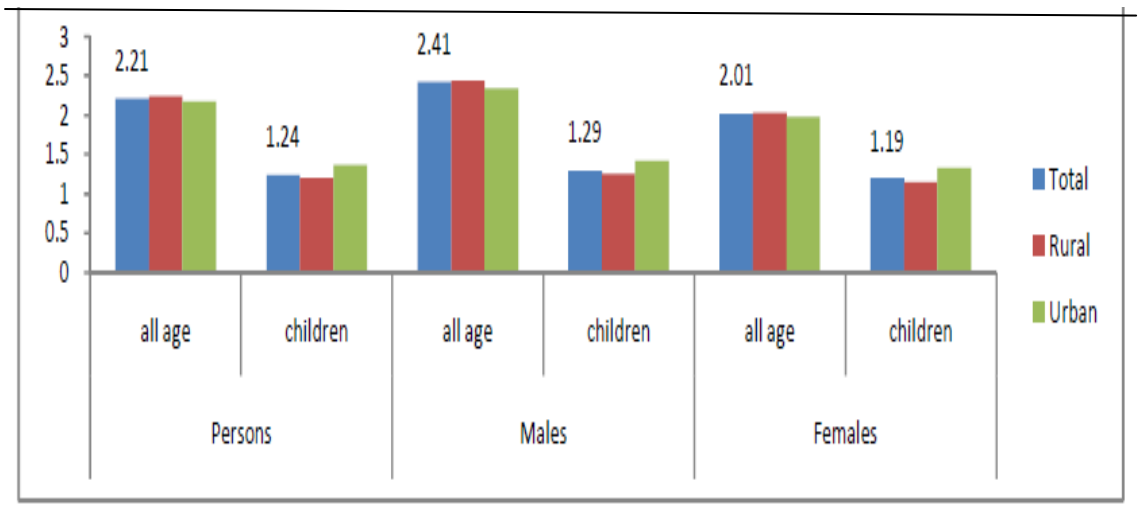


Figure 4: Disability statistics among children in rural and urban areas.

DISTRIBUTION OF DISABLED POPULATION IN INDIA – CENSUS, 2011

As per census 2011, 23% of the disabled children (0-6 years) are having disability in hearing, 30% inseeing and 10% in movement. 7% of the disabled children have multiple disabilities. A similar pattern is observed among male and female disabled children[25] shown in figure 5.

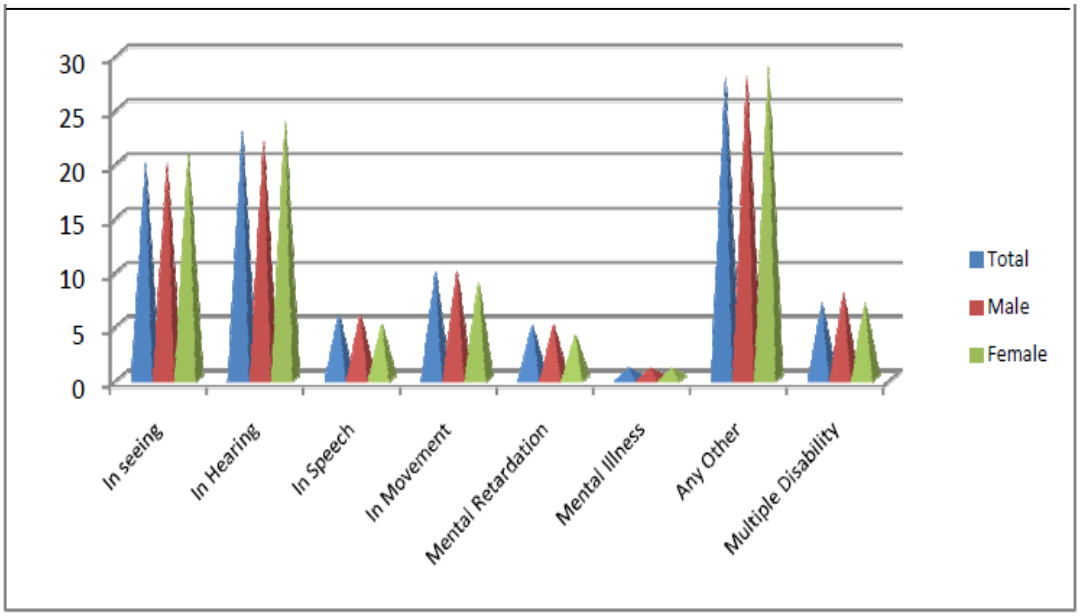


Figure 5: Distribution of multiple disabilities among children(0-6years).

After the discussion on statistics of developmental disabilities in world and our nation. A study done on using standardised screening tools reveals that only about 25% of children with developmental delays are detected prior to school entrance. It is common in early childhood affecting at least 10% of the Indian children[26].

National president, IAP (Indian Academy of Pediatrics) 2014-15 also stated that, Globally about 200 million children do not reach their developmental potential in the first five years of age[27]. Hence there is a need to assess development of children at earlier age using appropriate screening tool and to identify children with developmental disabilities.

Before starting with the history and description of known existing screening tools, let us know about what is a good screening test.

Screening test

The existence of a good screening test is hypothetical, the WHO criteria to be fulfilled for a good screening test[28] are:

- The condition screened for should be an important one
- There should be an acceptable treatment for patients with the disease
- The facilities for diagnosis and treatment should be available
- There should be a recognised latent or early symptomatic stage
- There should be a suitable test or examination which has few false positives - specificity - and few false negatives - sensitivity
- The test or examination should be acceptable to the population
- The cost, including diagnosis and subsequent treatment, should be economically balanced in relation to expenditure on medical care as a whole.

Developmental surveillance: which is the longitudinal process of identification and monitoring of newborns and children at high risk. This comprises of eliciting parental concerns, acquiring developmental history, identifying risk and protective factors, evaluation, and maintenance of records[29].

Screening is the brief cross-sectional process of evaluating children by screening tools with good psychometric qualities (sensitivity and specificity >70-80%)[30].

The screening tests available to assess the development of a child may be **clinician rated or parent rated**[31].

Parent rated, that is information collected from completed questionnaires are most of the times less expensive, easy to interpret, does not require training and provide a logistic approach to monitor development and aids in addressing developmental problems[31,32].

Ages and Stages Questionnaires, Brigance Screens-II, Parents' Evaluations of Developmental Status, ICMR-psychosocial screening test and Infant–Toddler Checklist for Language and Communications are some of the parent-rated screening tools[31,32].

Clinician-rated tests are used by clinicians, to complement the results of parent-report measures with appropriate observations and examinations[31,32].

Gesell's Developmental Schedule, Bayley Infant Neurodevelopmental Screener, Denver Developmental Screening Test, Developmental Activities Screening Inventory and INCLEN neuro-developmental tool are some of the clinician-rated tools used in developmental assessment of a child[31,32].

Developing these screening tools in past took a lot of effort from many renowned persons in field of child development.

HISTORICAL ASPECTS ON DEVELOPEMNTAL ASSESSMENT OF CHILD AND DEVELOPEMENTAL SCREENING TOOLS

Charles Darwin(figure 6) in 1877 published a detailed account of development of children[33].

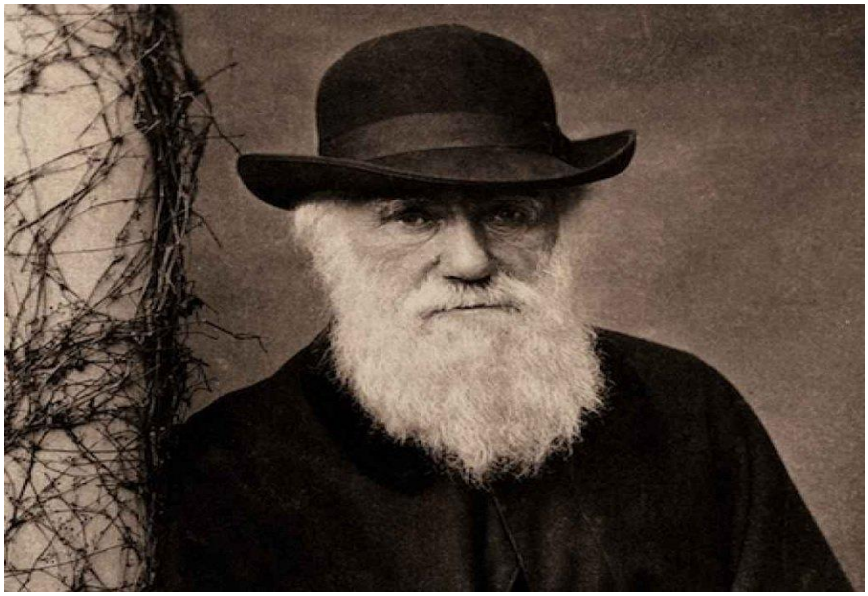


Figure 6: Charles Darwin.

In 1893, Shinn published one of the most complete records of a young baby's development. In 1931, Shirley wrote an extremely full account of 25 children in their first 2 years. It's fascinating to know how a neonate develop to an infant, child and an adolescent. The term developmental quotient (DQ) is used in case of toddlers and young children when the developmental age is measured in place of mental age[33].

A large series of books followed on established 'norms' of development, describing the development of infants and children from just after the newborn period to the age of 5 years. The philosophy of development, the technique of developmental testing and the interpretation of results are all discussed in detail in these books[33].

In 1954, Ruth Griffiths tested 571 children aged 14 days to 24 months—up to 31 children in each monthly period. In 1967, the **Denver study** was published, based on a sample of over 1000 children, a sample, however, which was 'selected' and not representative of the country as a whole. A revised and abbreviated **Denver screening test**, taking 5–7 minutes, was later described[34].

Currently in literature, there are many number of screening tools existing and used worldwide.

DEVELOPMENTAL SCREENING TOOLS

If developmental delay / disabilities left untreated, may results in to school failure and secondary health problems. The consequences will be unemployment, incarceration and dependency[35].

Developmental screening in INDIA is challenging, inspite of existence of many screening tools[36].

Challenges faced by primary care physician /health worker in implementing screening tools[36] are:

1. Over confidence in effectiveness of informal identification method.
2. Overdependence on clinical and laboratory judgments.
3. Over focusing on acute complaints and thus missing underlying issue.
4. Lack of familiarity with developmental screening tools.
5. Excessive optimism.

These taboos to be broken, in a review article where several screening tools were analysed and compared, concluded that there still exists a lacuna on using screening tool which can be used at primary health care centres. The study also emphasized that

one of the main reasons for lack of community-based data on developmental disabilities from India is the absence of routine developmental screening and surveillance[37].

In a review article, a list of screening tools used in India were compiled and reviewed. As a result, they emphasized on symptomatic approach to children with developmental concern using appropriate screening tools and help improve their future[10].

A study was conducted on perceptions and practices of 90pediatricians from Gujarat. Majority of participants (97.3%) reported that parents expressing developmental concerns are not evaluated in time and only 13.6% of practitioners used structured tools for evaluation. Reasons cited by the study for not using screening tools were time constraints (72%), non availability of treatment or referral options (45%) and inability to use screening tools (28%). Hence they emphasised on a need to structure a screening tool which can be used appropriately at primary health care setting[38].

Few screening tools used in western countriesare described in table 2:

Factors	DDST II[39]	BINS[40]	PEDS[41]	ASQ[42]
Age	0-6 years	3-24month	0-8 years	1-66 months
Format	Directly administered	Directly administered	Parent report	Parent report
Items	125	11-13	10	22-36
Results	Normal/abnormal/questionable.	High/low moderate	Low/medium/high	Pass/fail
Time	10-20 mins	10mins	2-10 mins	10-15 mins
Sensitivity	56-83%	75-86%	74-79%	70-90%
Specificity	43-80%	75-86%	70-80%	76-91%
Cost	$111	$325	$30	$249

Table 2 : Characteristics of developmental screening tools used in western countries.

Few screening tools developed in INDIA are described in table 3:

Factors	BDST[43]	TDSC[44]	ICMR tool[45]
Age	0-30 months	0-24 months	0-6 years
Format	Directly administered	Directly administered	Parent report
Items	54	17	66
Results	DQ calculated	Within age range	<50th centile
Sensitivity	65-93%	66.8%	-
Specificity	77.4-94.4%	78.8%	-
Cost	Inexpensive	Inexpensive	inexpensive

Table 3: Developmental screening tools used in INDIA.

In our study we used ICMR-psychosocial screening tool and INCLEN neurodevelopmental tool to assess development of child which is described below:

ICMR- psychosocial screening tool

In India, many attempts have been made to establish developmental norms for school children, still the results are not satisfactory.

A cross-sectional multi-centric study was therefore conducted under the guidance of ICMR and WHO to develop a screening tool for early detection of developmental disabilities in children under 6 years of age, in 1991 in 3 centres (Chandigarh, Hyderabad and Jabalpur). As a result, ICMR-psychosocial screening tool was developed and standardised to screen children at health centres for developmental disabilities[45].

ICMR-psychosocial screening tool consists of set of 66 items in a semi-structured questionnaire format. Which comprises of five major areas namely Gross motor, Vision and fine motor, Hearing language and concept development, self help skills and social skills[45].

The questionnaire proforma to be filled by mothers/caretakers. All the children will be assessed for the items relevant for their age. The age of attainment of a milestone at the 50th centile will be used for placement of that item and taken as a reference. Using the software developed by WHO the data has to be analysed and centile to be plotted. Any child who did not achieve the milestone upto reference standard will be considered in group of delayed milestones in respective five major classes[45].

INCLEN - neurodevelopmental screening tool

The INCLEN study group developed and validated a tool for detection of NMI, that employs standardized and uniform criteria for use in 2-9 year old children.It has been developed by 55 experts, and studied on 454 children selected through systematic random sampling from Paediatric neurology speciality clinics of 3 tertiary centres in India. The test had good sensitivity and specificity[11].

The INCLEN tool thus comprises of three sections:

Section-I (Triage questions): consists of four questions to elicit information from the parents/primary caregiver of the child regarding attainment of selected motor developmental milestones.

Section-II (Observations): Physician makes three observations for assessing hand function, gait and muscle weakness.

Section-III: consists of six questions, and the operator does the neurological examination necessary for confirmation of NMI.

Thus final diagnosis of NMI is derived through an algorithm based on interpretation of three sections (i.e. 13 questions/items).

The final diagnosis informs whether the case has cerebral palsy (CP), neuromuscular disorders (NMD), Other NMI (that does not fit in to either CP or NMD), no NMI or an indeterminate clinical condition[11].

Advantages of INCLEN tool are: it is simple to administer, requires less time and comprises of observation and examination sections when compared to ICMR tool, which is solely based on information provided by the parents[11]. As it is a newer tool, its performance needs to be systematically evaluated in primary care settings of different geographic regions and thus calls for the more studies using INCLEN tool.

Developmental assessment of children

A study was done in the year 2013 to find out developmental profile of children less than two years. In this study Psycho-social development was assessed using ICMR Screening Test. Study population comprises of 384 children under two years from the coastal area of Kochi, Kerala. Developmental delay using ICMR screening test ranged from **1.3 to 8.1%**[46].

A cross sectional study conducted in an urban slum of Delhi to screen infants for psychosocial development using ICMR-psychosocial screening tool. Total of 202 infants and their mothers were included in the study. The study found that majority of infants have delayed development in vision and fine motor and self help skills compared to other milestones[47].

A descriptive study done on assessment of developmental delay among urban infants and toddlers using ICMR-psychosocial screening tool. A total of 468 children were assessed**, 7.1 %** of children were found to have global developmental delay and in this study majority of them belong to the age group of 0-12 months[48].

A community based cross sectional study done in year 2016 on 520 children to screen for developmental delay using ICMR –psychosocial screening tool. In this study, 10.6% of children under 5 years were found to have developmental delay, maximum number of children**(10.1%)** were found to have delay in the domain of language, concept development compared to gross motor, vision & fine motor and social & self help skills[49].

The study was done in Udhampur district on 30 Gujjar tribe children, to screen the children for developmental delay using ICMR- Psychosocial screening tool. The study revealed majority (93.33%) of children achieved all developmental milestones in time. Only 2 children were found to have delay in development. The study highlights in-spite of unsatisfactory living conditions, most Gujjar children have attained developmental milestones in time[50].

In a cross sectional study where4000 households in 6 regions of INDIA were sampled for developmental screening by using INCLEN tool. In this study, they found 7.5% to 18.5% children aged 2-9 years suffer from one or more neurodevelopmental disorders, 10% from hilly areas, 13% in urban areas and 18% of rural areas countrywide excluding tribe.The study revealed on an average prevalence rate of 4.7% to 13.7%[51]**.**

In a study done byGulati S et al**,** 454 children aged 2-9 years were assessed for neuro-motor impairment selected through systematic random sampling. The study showed

among 454 children, 66 children had neuro-motor impairment, 105 children had neuro-motor impairment along with other neurodevelopmental disorders, 225 children had neuro-developmental disorder without neuro-motor impairment and 58 children are normal. The overall sensitivity of INCLEN tool in this study was 75.4% and specificity of 86.8%[11].

Developmental disabilities and demographic background

In a study conducted in urban slums of DELHI using ICMR tool, revealed that more developmental delay was found in children with the advancing age. Which revealed that percentage of developmental disabilities was found more as the age increases. Boys were found to have more developmental delay compared to girls[47].

In a study done in Kochi using ICMR tool, showed that boys had more developmental delay compared to girls. More number of developmental delay was found at the age of 1 to 2 years[46].

In a descriptive research having sample of 100 children with intellectual disability attending a special school in Calicut, Kerala were evaluated for NMI using a INCLEN tool. More number of male children were found to have NMI compared to female children[52].

Developmental disabilities and nutritional status of children

In a cross sectional study done on urban infants and toddlers using ICMR tool revealed children with under-nutrition and stunting had more developmental delay compared to children with normal nutritional status. The study concluded that undernutrition has significant association with developmental status of a child.[48]

In a descriptive study done on 330 children revealed that 52-60% of children had deficient in both macro and micronutrients. The children with nutrient deficiencies were found to have more delay in development. The association between them were established in the study.[53]

In a cross sectional study, 202 infants and their mothers were included conducted in Raja bazaar in 2002. Growth parameters assessed were: weight and length for age and developmental assessment by ICMR tool. Development was delayed in significantly higher percentage of underweight than normal infants (p value <0.05): gross motor (15.3% & 4.5%), Vision &fine motor (21.1%, 4.6%) and social skills (27.6%, 12.1%). Development of gross motor milestones was also delayed in significantly high percentage of stunted infants(22.2%). The association of undernutrition with delay in development was described.[54]

COMPARATIVE STUDIES DONE IN SEARCH OF AN IDEAL DEVELOPMENTAL SCREENING TOOL

In literature search, several attempts have been made to search for an ideal developmental screening tool, the results are not satisfactory....

A pilot study was done in an attempt to describe growth and developmental characteristics of homeless children and to compare a parent-completed measure with professionally-conducted developmental screening results. It is a prospective, comparative study was conducted on 20 homeless mothers and their 21 children. Health professionals used the Denver Developmental Screening Test II, identifying nine children with possible language delay. Mothers completed the Ages and Stages Questionnaires and identified three areas of concern: fine motor (n = 9), communication/language (n = 4), and problem solving (n = 4). The percentage

agreement between these two tools was strongest in gross motor (95%) and personal social development (95%) but weakest in language development (67%). The study emphasized to use tool which consists of parameters like observations and tests done by health professionals compared to screening tests which solely depends on parent completed questionnaire[55].

A study done on children to estimate the sensitivity and specificity of two parent-completed developmental screening measures—the Ages and Stages Questionnaire (ASQ) and the Parents' Evaluation of Developmental Status (PEDS). A sample of 334 children aged 12 to 60 months was recruited. Parents completed the PEDS and the ASQ tests. The presence of >1 predictive concerns or abnormal domains was considered a positive screen. All children underwent evaluation (administered by a psychologist) with the following criterion measures: the Bayley Scales of Infant Development. Developmental delay was identified in 34 children (10%). The PEDS had moderate sensitivity (74%) but low specificity (64%); compared with the ASQ which had significantly higher sensitivity (82%) and specificity (78%). The study concluded ASQ seems to have higher sensitivity and specificity across a variety of age groups, the choice of this measure to use should be determined by the practice setting, population served, and preference of the physician[56].

In a pilot study of comparison of two screening tool(Rourke Baby Record and Nipissing District developmental screening tool) with gold standard test(Bayley screening tool) to detect developmental delay at 36 month was done in year 2010 - 2011 on 64 children. The results showed sensitivity of 75% for both the screening tools and specificity of 93 % for Rourke Baby Record and 96 % for NDDS. The study emphasized that both the tools appears to be promising, but needs further large

studies to be used when compared to gold standard test which is being used in the country.[57]

A study done in South Africa to compare the accuracy of road to health booklet (RTHB) against a standardized international tool (PEDS). 201 children were screened using both the tools and found that RTHB has low sensitivity but high specificity. Hence it was emphasized in the study to replace the tool RTHB with PEDS Tool in order to improve earlier identification of developmental delay as a screening tool.[58]

Still the results are in-conclusive, Many children who have neuro-motor impairments or developmental disabilities are often seen only in primary care settings.

There is a strongly felt need to develop more culturally appropriate, norm-based, valid and reliable Indian developmental screening instruments. In this study, an attempt has been made to assess the development of children using ICMR and INCLEN tool, and to compare INCLEN with existing standardised ICMR screening tool.

METHODOLOGY

MATERIALS AND METHODS

The study was conducted after taking ethical clearance from the institution and children were included in the study after obtaining consent from parents/guardians.

Study design: A cross sectional comparative study.

Place of data collection: Anganwadi's of Kolar town.

Participants: Children aged 2-6 years attending Anganwadi's of Kolar town.

Study period: January 2016-December 2016**.**

Developmental screening tools:

Developmental assessment of children included in the study was done using the two developmental screening tool-

1. ICMR – psychosocial developmental assessment screening tool.

2. INCLEN – neuro-developmental screening tool.

Inclusion Criteria:1. The children aged 2-6 years were included in the study after taking consent of parents or guardian.

Exclusion Criteria:1. Children with diagnosed neurodevelopment impairment or disability.

2. Children with acute illness.

SAMPLE SIZE CALCULATION:

1. Sample size is estimated based on the proportion of developmental delay as measured by

    1. ICMR Psychosocial assessment tool (reference study no45.) with prevalence of about 7.5%(p1).

    2. INCLEN - neuro-developmental screening tool (reference study no 11.) with prevalence of about 18%(p2).

With an average prevalence of developmental delay by 2 methods was 12% (p).

Sample size:

$$n = \frac{2\,PQ(Z_{\alpha} + Z_{1-\beta})^2}{(d)^2}$$

Where, n= sample size.

Z_{α}=standard deviation 1.96(which is at 95%confidence intervals).

$Z_{1-\beta}$= standard deviation 1.28

p=prevalence.

q=100-p.

d=p1-p2.

With 90% power and at 95% confidence intervals, with 5% absolute error, to detect a difference of 10.5%the estimated sample size was 212.

Expecting a non-compliance of 10%, sample size calculated was **234**.

Sampling design:

A sample size of 234 children was calculated.

All available children in anganwadi was included in the study, so that the standards which was found would not be skewed towards any particular group. This meant that the findings and the developmental milestones was representative of the population as a whole.

Variables :

Age group of children: Age stratification into four groups was adopted; 24 to 36 months, 37-48months, 49-60months, 61-72 months of age.

Sex:study population was described as male and female population.

Weight for age and sex:

Weight of the child was recorded using electronic type of weighing scale in the minimal clothing (The weighing scale was corrected for any zero error before measurement).

The study children were classified into following groups using WHO MGRS standards[59]:

Severe malnutrition: a score of less than -3SD for age and sex.

Moderate malnutrition: a score of more than -2SD to -3SD for age and sex.

Mild malnutrition: a score of -1SD to -2SD for age and sex.

Normal for age: a score of more than -1SD to +1SD for age and sex.

Overweight: a score of +2SD to +3SD for age and sex.

Obesity: a score of more than +3SD for age and sex.

Length/height for age and sex:

Length was measured placing the child in a supine position on a rigid measuring table. The head was held firmly in position against a fix upright headboard and legs are straightened, keeping feet at right angles to legs and with toes pointing upward. The free foot board was brought into firm contact with the child's heel. Length of the child was measured from a scale which is set in measuring table.

Standing height: child stands upright, heels are slightly separated and the weight is borne on evenly on both feet. Heels, buttocks, shoulder blades and back of the head was brought in contact with the vertical surface such as wall. Head was so positioned that child looks directly forwards with Frankfort plane and the bi-auricular plane being horizontal.

The study group children were classified as below as per WHO MGRS standards[59]:

Normal length/height : it is defined as length/height in the range of -2SD to +2SD for given age and sex.

Short stature: it is defined as height more than 2 SD below the median height for age and sex.

Head circumference for age and sex: After removing hair ornaments and braids, the maximum circumference of the head from the occipital protuberance to the supra-orbital ridges on the forehead of all children included in study was measured using non stretchable measuring tape.

Children were classified according to head circumference for age and sex as below using WHO MGRS standards[59].

Normal head circumference: it is defined as head circumference in the range of -2SD to +2SD for given age and sex.

Microcephaly: it is defined as an occipitofrontal circumference more the 2 SD below the mean for given age and sex.

Severe microcephaly: It is defined as an occipitofrontal circumference more the 3 SD below the mean for given age and sex.

Macrocephaly: It is defined as an occipitofrontal circumference more the 2SD above the mean for given age and sex.

Socio economic classification: socioeconomic status was determined using BG Prasad's classification.[60]

Social class	**Per capita monthly income limits (May 2016) in rupees.**
I	6277 and above
II	3139 – 6276
III	1883 – 3138
IV	942 – 1882
V	Less than 942

Table 4: BG Prasad's classification

Outcome after assessing children using ICMR tool:

The developmental assessment was done using ICMR-psychosocial developmental screening test(Annexure-I) comprising by five major areas: 1) gross motor

2) fine motor and vision, 3) hearing , language and concept development, 4) self help skills and 5) social skills.

Information regarding the attainment of developmental milestones was collected from parents/guardians as per proforma (Annexure-I).

The age of attainment of a milestone at the 50^{th} percentile of age was taken as **development appropriate for age.**

Children whose attainment of developmental milestones below 50^{th} percentile of age was taken as **developmental delay.**

All the children were assessed for the items relevant for their age.

Outcome after assessing children using INCLEN tool:

Using INCLEN tool (Annexure-II) the children were assessed for neuro developmental disabilities with the following outcomes:

Section-I (Triage questions) : information collected by the parents/guardians.

Section-II (Observations): were done by the Pediatric post graduate.

Section-III: was completed by the Pediatric post graduate.

Thus final diagnosis of NMI was derived through an algorithm(Annexure-III) based on interpretation of three sections (i.e. 13 questions/items).

This tool approximately required 20-25 minutes for assessing each child.

Examination of cranial nerves and sensory neurologic system examination is not included in the tool as these are not directly relevant for making diagnosis of NMI.

The final outcomes at the end of the study informs the child has NMI or not.

NMI in the form of cerebral palsy (CP), neuromuscular disorders (NMD), Other NMI (that does not fit in to either CP or NMD), no NMI or an indeterminate clinical condition.

Comparison of INCLEN tool with standardised ICMR TOOL

After obtaining results from the data analysed, appropriate psychometric parameters were used to compare INCLEN tool with ICMR tool. The acceptable definitions and standards for developmental tool are described in table no 5:

Term	Description	Acceptable standard
Sensitivity	Percentage of children with delay/problem who are correctly identified by the screening test.	70-80%
Specificity	Percentage of children without delay/problem who are correctly identified by the screening test.	≥80%
Positive predictive value	Percentage of children with delay/problem by the screening test who do indeed have the delay/problem.	30-50%
Negative predictive value	Percentage of children identified as normally developing by the screening test who are indeed developing normally.	30-50%

Table 5: Acceptable Standards of Psychometric Parameters

STUDY METHODOLOGY

A cross sectional comparative study was conducted at 14 Anganawadi's of kolar town. After obtaining permission from the institutional review board and written informed consent from the parents.

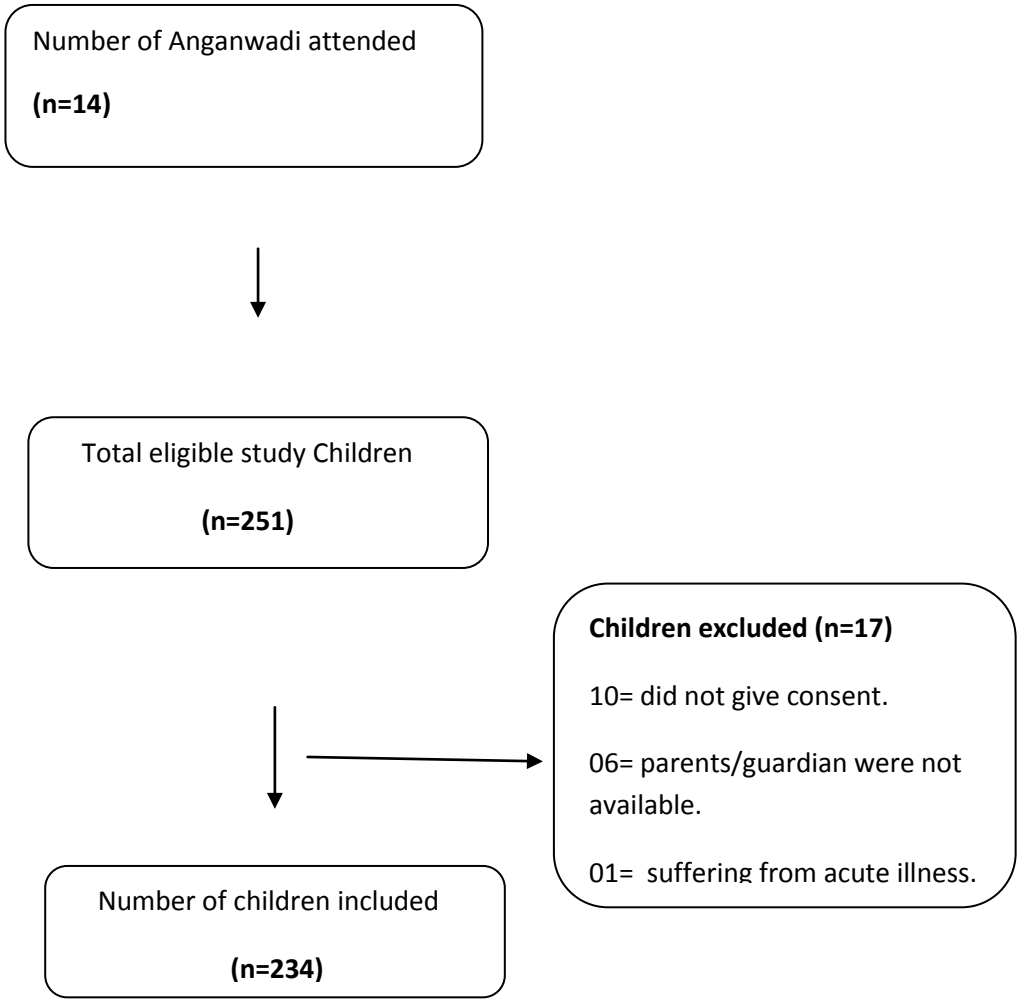


Figure 7: Flow chart showing the study population.

The socio demographic details of children were taken from the proforma filled by parents/guardians. Anthropometric measurements were taken from pediatric post graduate.

The study children were classified as obese, overweight, normal weight, malnourished(mild, moderate and severe) according to weight for age and sex.

The study population was classified as normal height or short stature as per age and sex.

The study children were classified as macrocephaly, normal , microcephaly and severe microcephaly according to head circumference for age and sex.

ICMR and INCLEN tools were applied on children at the same time and outcomes were derived.

The association of demographic details and anthropometric parameters with outcomes of two screening tools were studied.

Only delay in motor components from two screening tools such as delay in gross motor and fine motor and vision domains were included from ICMR tool and cerebral palsy, other NMI and NMD outcomes were included from INCLEN tool. These outcomes were compared using appropriate psychometric parameters in our study.

Children with delay in other three domains using ICMR tool and INDETERMINATE results using INCLEN tool were excluded from comparison.

RESULTS

Statistical analysis

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions.

Chi-square test was used as test of significance for qualitative data. Yates correction was applied where ever applicable.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram and Pie diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data. EPI Info (CDC Atlanta), Open Epi, Med calc and Medley's desktop were used to estimate sample size and reference management.

Statistical methods for diagnostic/screening studies were applied for calculating sensitivity and specificity for comparing the two screening methods.

RESULTS

Demographic data:

Table 6:- Distribution of study children according to Age group.

Age group	Frequency	Percent
24-36months	72	30.8
37-48months	89	38.0
49-60months	57	24.4
61-72months	16	6.8
Total	234	100.0

In the study, out of 234 children, majority of children were below 60 months(93.2%). Less number of children belongs to the age group of 61-72 months. (Table 6 & Figure 8)

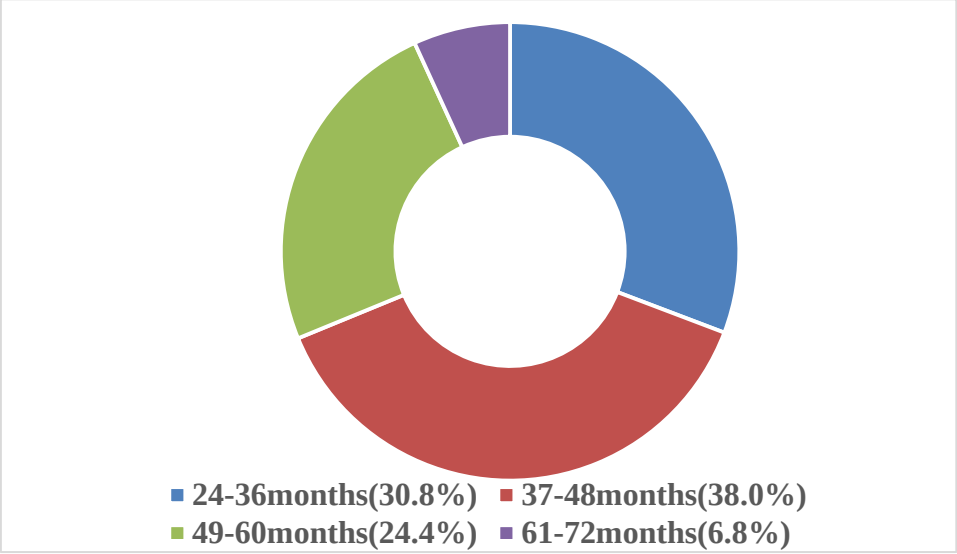


Figure 8: Graph showing Distribution of study children according to Age group.

Table 7:- Distribution of study children according to sex.

SEX	Frequency	Percent
Male	125	53.4
Female	109	46.6
Total	234	100.0

In our study, it was observed that 53.4% of children belong to male population and 46.6% of children belong to female population.

(Table 7 & Figure 9)

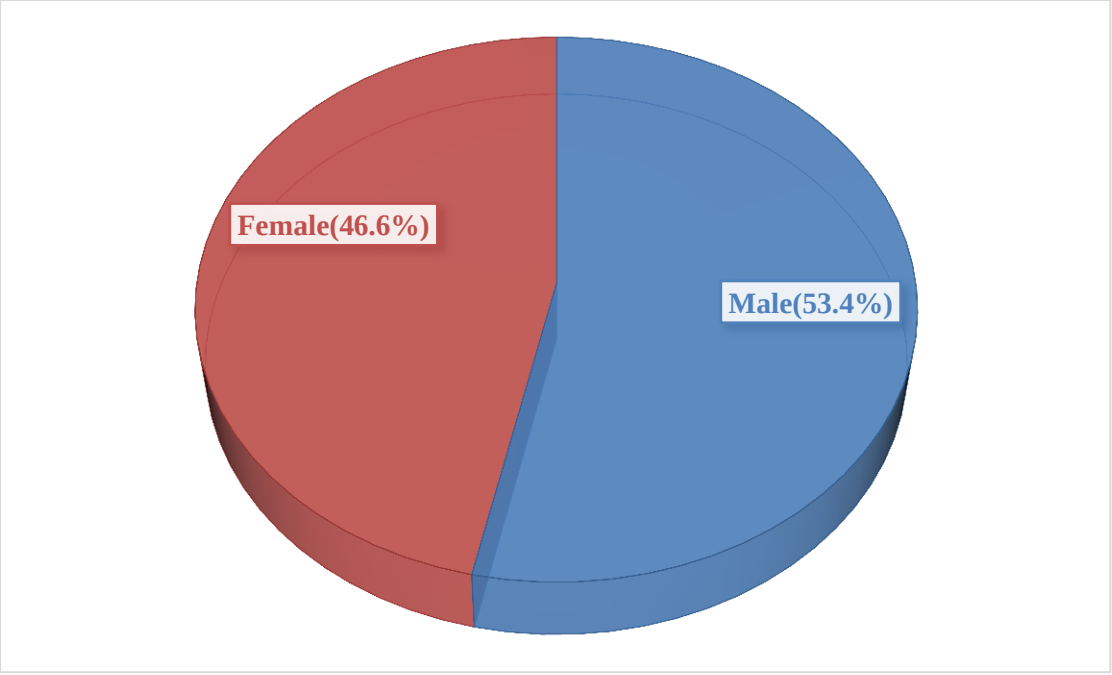
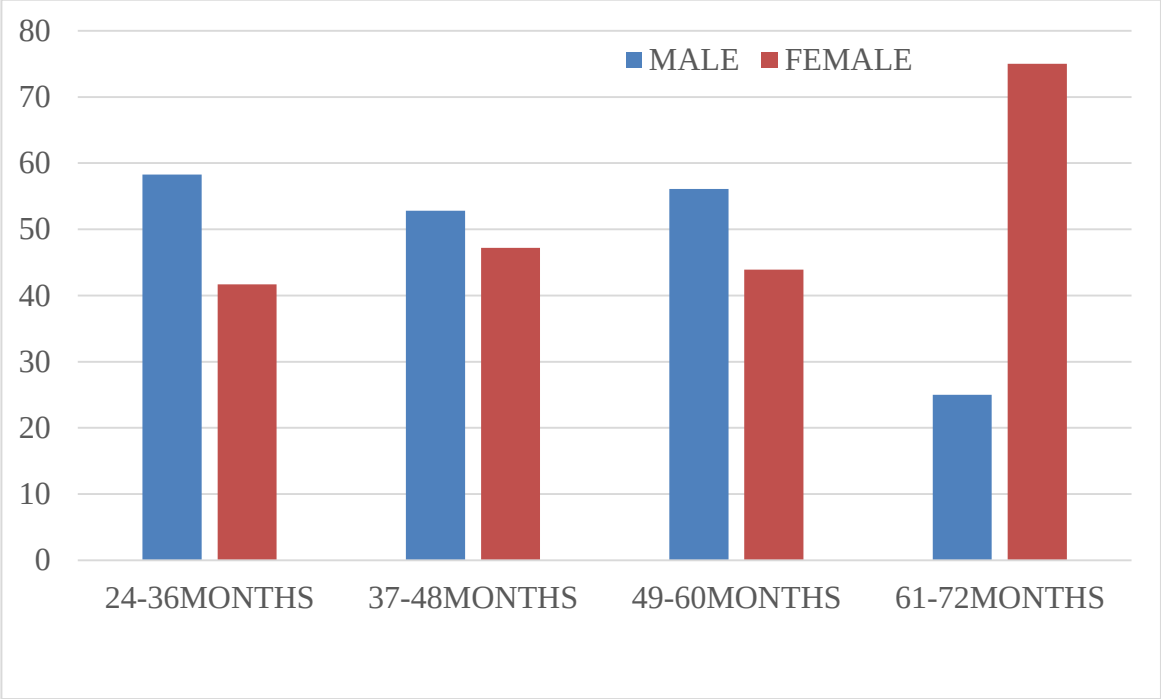


Figure 9:- Graph showing Distribution of study population according to sex.

Table 8:- Distribution of study children according to Age group and sex.

SEX	Age (in months)				Total
	24-36	37-48	49-60	61-72	
Male	42	47	32	4	125
	58.3%	52.8%	56.1%	25.0%	53.4%
Female	30	42	25	12	109
	41.7%	47.2%	43.9%	75.0%	46.6%
Total	72	89	57	16	234
	100.0%	100.0%	100.0%	100.0%	100.0%

In the present study, male preponderance was observed in all age groups except for the age group of 61-72 months, where majority(75%) of children were females. (Table 8 & Figure 10)



Chi square Value = 6.07, P value = 0.108

Figure 10:- Graph showing Distribution of study children according Age group and sex.

Table 9: Distribution of study children according to weight for age.

Weight for age	**Number of children(n=234)**
Severe malnutrition	2(0.9%)
Moderate malnutrition	10(4.3%)
Mild malnutrition	89(38.0%)
Normal	122(52%)
Overweight	11(4.7%)
Total	234(100%)

It was observed that, 52% of children were normal.38% of children belong to mild malnutrition, followed by 4.3% and 0.9% of children belongs to moderate and severe malnutrition respectively.

Less number of children(4.7%) were overweight.(Table 9 & Figure 11)

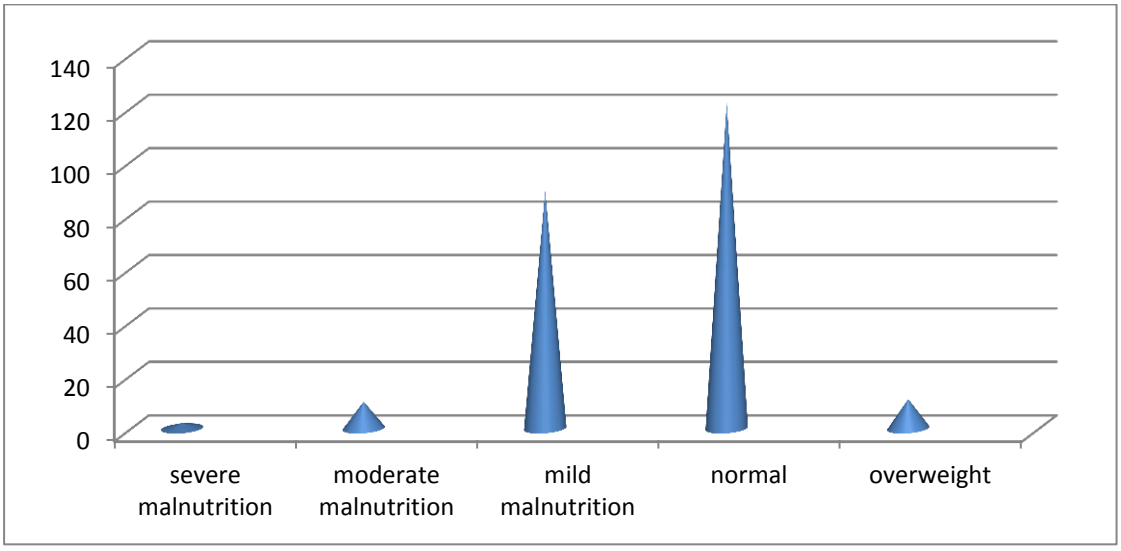


Figure 11: Distribution of study children according to weight for age.

Table 10:Distribution of study children according to height/length for age.

Height/length for age	**Number of children(n=234)**
Normal	221(94.4%)
Short stature	13(5.6%)
Total	234(100%)

In our study, short stature was found in 5.6% of children, others were normal.(Table 10 & Figure 12)

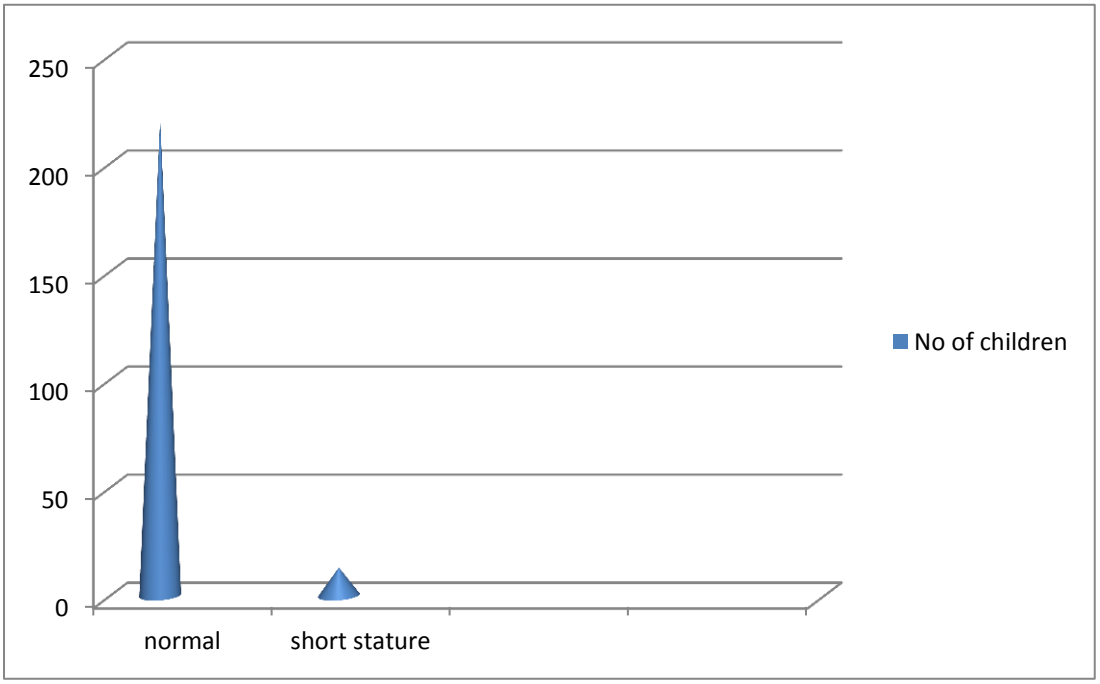


Figure 12: Distribution of study children according to height/length for age

Table 11: Distribution of study children according to head circumference for age.

Head circumference for age	Number of children(n=234)
Normal	219(93.6%)
Microcephaly	13(5.6%)
Severe microcephaly	2(0.9%)
Total	234(100%)

It was observed that, Microcephaly and severe microcephaly was found in 5.6% and 0.9% of children respectively, others were normal.(Table 11 & Figure 13)

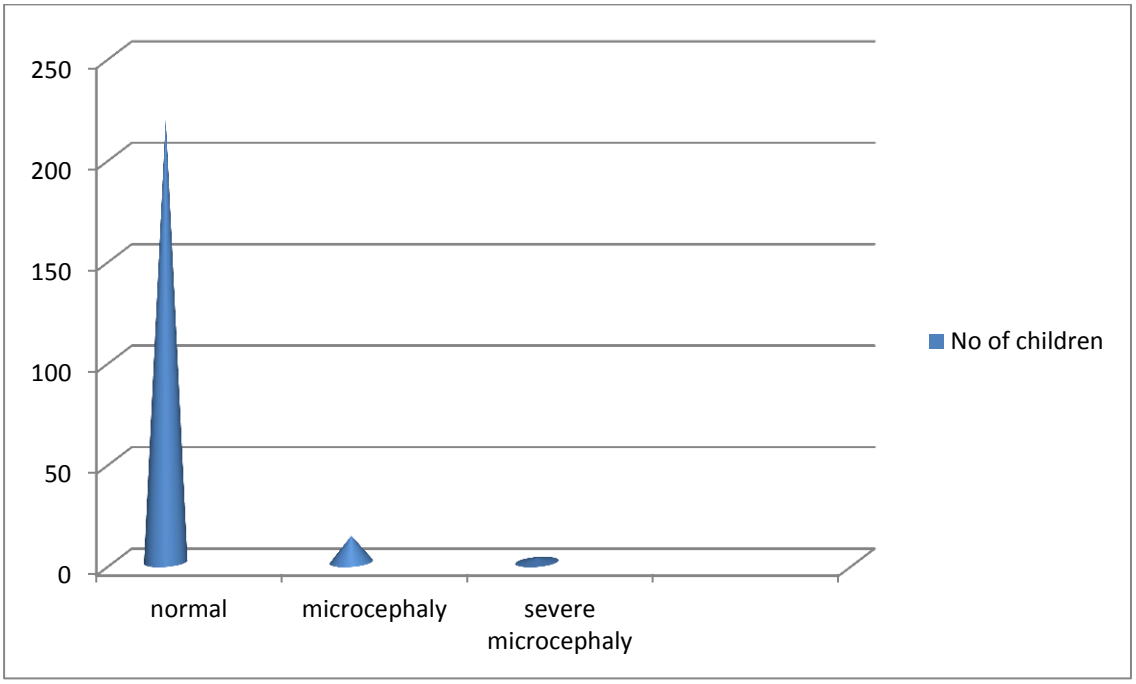


Figure 13: Distribution of study children according to head circumference for age.

Table 12: Distribution of study children according to socio economic strata of their family.

Socioeconomic strata of their family	**Number of children(n=234)**
Class III	112(47.9%)
Class IV	120(51.3%)
Class V	2(0.9%)
Total	234(100%)

In our study, 47.9% and 51.3% of children belong to class III and class IV respectively.Only 2 children belong to class V.

(Table 12 & Figure 14)

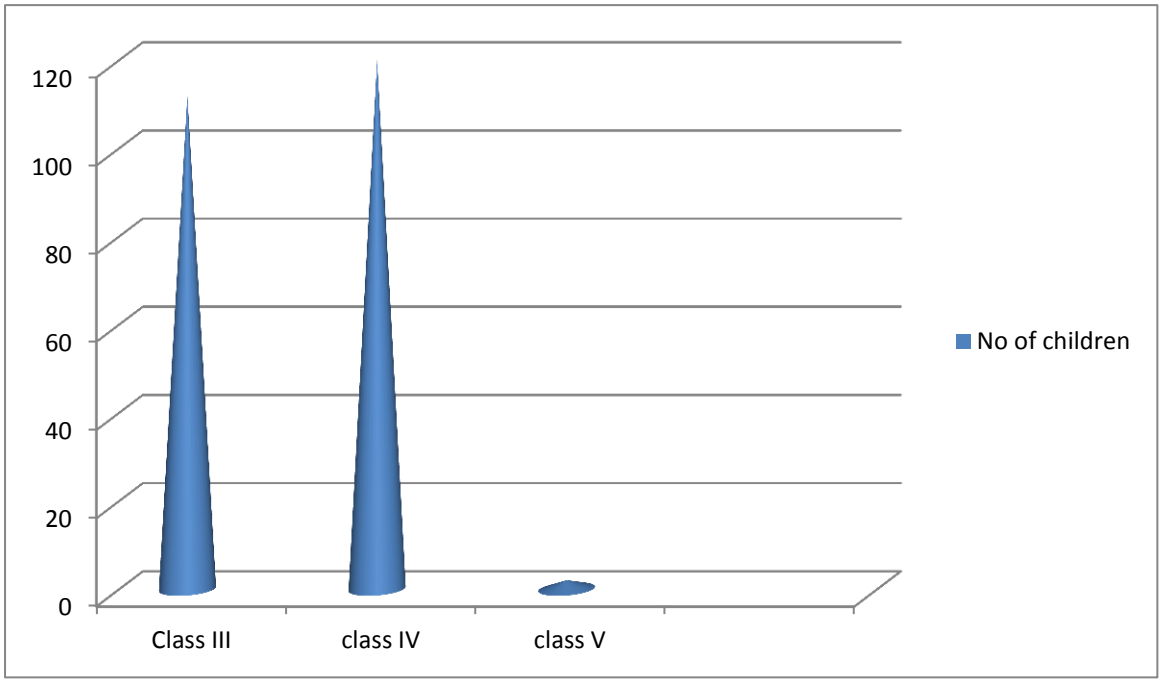


Figure14: Distribution of study children according to socio economic strata of their family.

Table13: Distribution of developmental disabilities as per ICMR-psycho-social screening tool.

Psychosocial screening tool	Milestones attained in time	Delay in development	Total (n=234)
Gross motor milestones	216(92.3%)	18(7.7%)	234(100%)
Fine motor and vision skills	215(91.9%)	19(8%)	234(100%)
Hearing, language and concept development skills	219(93.6%)	15(6.4%)	234(100%)
Social skills	226(96.6%)	8(3.4%)	234(100%)
Self help skills	218(93.1%)	16(6.9%)	234(100%)

In our study, majority of children had normal development in all the five domains.**3.4% - 8%** of children had delay in development.

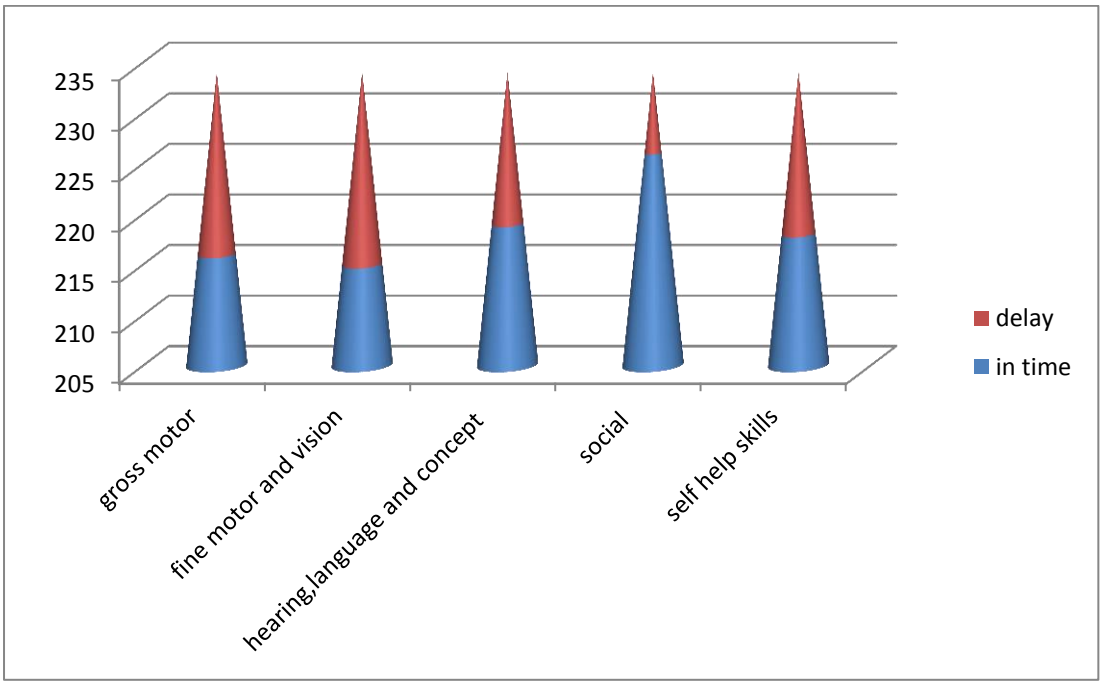


Figure 15: Distribution of developmental disabilities as per ICMR-psychosocial screening tool.

Table 14:- Distribution of psychomotor skills in study population according to age as per ICMR-tool.

Psychosocial screening test.	Age of children				Chi square value	P value
	24-36 M N=72	37-48M N=89	49-60M N=57	61-72M N=16		
Gross motor skills In time Delay	68(94.4%) 4(5.6%)	81(91.0%) 8(9.0%)	51(89.5%) 6(10.5%)	16(100%) 0	1.28	0.732
Vision and fine motor skills In time Delay	66(91.7%) 6(8.3%)	82(92.1%) 7(7.9%)	52(91.2%) 5(8.8%)	15(93.8%) 1(6.3%)	0.11	0.989
Hearing, language and concept development skills In time Delay	69(95.8%) 3(4.2%)	83(93.3%) 6(6.7%)	53(93.0%) 4(7.0%)	14(87.5%) 2(12.5%)	1.64	0.649
Social skills In time Delay	70(97.2%) 2(2.8%)	85(95.5%) 4(4.5%)	55(96.5%) 2(3.5%)	16(100%) 0	0.59	0.898
Self help skills In time Delay	69(95.8%) 3(4.2%)	83(93.2%) 6(6.8%)	51(89.5%) 6(10.5%)	15(93.8%) 1(6.3%)	2.03	0.567

Table 14 show distribution of psychomotor skills as per age, where delay in development was distributed equally in all age groups in all the five domains of development.

In contrast to above, there was no delay in development among children of age group 61-72 months for gross motor and social skills domains.

No statistical significant correlation was found between age group and attainment of developmental milestones.

Table 15:- Distribution of Psychomotor Skills in study children according to sex as per ICMR-tool.

Psychosocial screening tool	Sex				Total (n=234)	Chi square Value	P value
	Male (n=125)		Female(n=109)				
	In time	Delay	In time	Delay			
Gross motor	115(92%)	10(8%)	101(92.7%)	8(7.3%)	234	0.035	0.850
Vision and fine motor	114(91.2%)	11(8.8%)	101(92.7%)	8(7.3%)	234	0.166	0.683
Hearing, language and concept development	116(92.8%)	9(7.2%)	103(94.5%)	6(5.5%)	234	0.279	0.597
Social skills	120(96%)	5(4%)	106(97.2%)	3(2.8%)	234	0.274	0.600
Self help skills	116(92.8%)	9(7.2%)	102(93.5%)	7(6.5%)	234	0.055	0.829

Table 15 depicts the association of gender with developmental milestones. It was observed that delay in attainment of developmental milestones were equally distributed among **males(4-8%)** and **females(2.8-7.3%),**which was not statistically significant.

Table 16: Distribution of Psychomotor Skills in study children according to weight for age as per ICMR-tool.

Psychosocial screening tool	Weight for age				Chi square value & P value
	Moderate and severe malnutrition (n-12)	Mild malnutrition (n=89)	Normal (n=122)	Overweight (n=11)	
Gross motor In time Delay	 9(75%) 3(25%)	 76(85.4%) 13(14.6%)	 120(98.4%) 2(1.6%)	 11(100%) 0	16.48, <0.001
Fine motor and vision In time Delay	 8(66.6%) 4(33.4%)	 76(85.4%) 13(14.6%)	 122(100%) 0	 11(100%) 0	21.06, <0.001
Hearing, language and concept development In time Delay	 10(83.3%) 2(16.7%)	 78(87.6%) 11(12.4%)	 122(100%) 0	 11(100%) 0	11.34, 0.01
Social skills In time Delay	 10(83.3%) 2(16.7%)	 83(93.3%) 6(6.7%)	 122(100%) 0	 11(100%) 0	7.68, 0.05
Self help skills In time Delay	 8(66.6%) 4(33.4%)	 79(88.8%) 10(11.2%)	 122(100%) 0	 11(100%) 0	19.97, <0.001

Among the group of malnutrition(moderate and severe), more number of children(16.7-33.4%) had delay in attainment of developmental milestones in all the five domains.

Among the group with mild malnutrition, 6.7 – 14.6% of children had delay in development.

Majority of children(98.4-100%) with normal nutrition and overweight had attained developmental milestones in time all the five domains.

On applying chi square test, the association between developmental delay in all the five domains and malnutrition was significant statistically. (p=<0.05)

Table 17:- Distribution of Psychomotor Skills in study children according to height/ length for age as per ICMR-tool.

Psychosocial screening test	Height/length for age		Chi square value	P value
	Normal (n=221)	Short stature(n=13)		
Gross motor				
In time	205(92.8%)	11(84.6%)	1.147	0.263
Delay	16(7.2%)	2(15.4%)		
Fine motor and vision				
In time	204(92.3%)	11(84.6%)	0.973	0.285
Delay	17(7.7%)	2(15.4%)		
Hearing,language and concept development				
In time	208(94.1%)	11(84.6%)	1.847	0.174
Delay	13(5.9%)	2(15.4%)		
Social skills				
In time	215(97.3%)	11(84.6%)	5.968	0.015
Delay	6(2.7%)	2(15.4%)		
Self help skills				
In time	207(93.2%)	11(84.6%)	1.596	0.209
Delay	14(6.3%)	2(15.4%)		

In the group with short stature, 15.4% of subjects showed delay in developmental milestones in all the five domains.

However, there was significant association between short stature and developmental delay for social skills domain. No association was found for other four domains(Table 17).

Table 18:- Distribution of Psychomotor Skills in study children according to head circumference for age as per ICMR-tool.

Psychosocial screening test	Head circumference for age			Chi square value	P value
	Normal (n=219)	Microcephaly (n=13)	Severe microcephaly (n=2)		
Gross motor In time Delay	209(95.4%) 10(4.6%)	6(46.2%) 7(53.8%)	0 2(100%)	47.05	<0.001
Fine motor and vision In time Delay	210(95.9%) 9(4.1%)	6(46.2%) 7(53.8%)	0 2(100%)	50.52	<0.001
Hearing, language and concept development In time Delay	212(96.8%) 7(3.2%)	7(53.8%) 6(46.2%)	0 2(100%)	58.86	<0.001
Social skills In time Delay	218(99.5%) 1(0.5%)	8(61.5%) 5(38.5%)	0 2(100%)	76.43	<0.001
Self help skills In time Delay	211(96.3%) 8(3.7%)	7(53.8%) 6(46.2%)	0 2(100%)	43.33	<0.001

It was observed that, in the group of severe microcephaly, 100% of children had developmental delay.

While 38.5- 53.8% of children with microcephaly had delay in development.Only 0.5-4.6% of children with normal circumference had delay in development.

Thus, association of developmental delay with microcephaly and severe microcephaly was found to be statistically significant (p = <0.001).

Table 19: - Distribution of Neuro- motor impairment in study children as per INCLEN-tool

INCLEN newer tool	Frequency	Percentage
No neuromotor impairment	192	82.1%
Cerebral palsy	8	3.4%
Neuromuscular disease	4	1.7%
Other Neuromotor impairments	17	7.3%
Indeterminate	13	5.6%
Total	234	100.0%

In our study, majority of children (82%) had no neuro-motor impairment.

Among children with NMI, predominant had other NMI(7.3%) and INDETERMINATE(5.6%) results.(table 19)

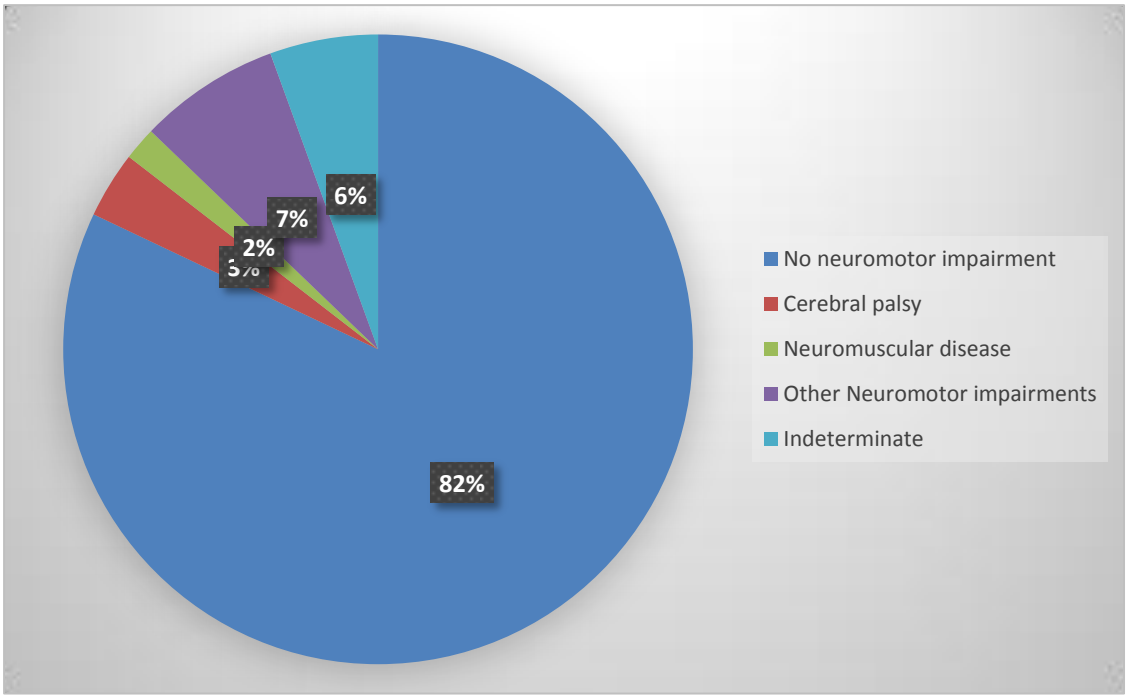


Figure 16: - diagram showing Distribution of Neuro- motor impairment in study children as per INCLEN- tool.

Table20 :Distribution of Neuromotor impairment in study children according to age as per INCLEN- tool

INCLEN newer tool	**Age (in months)**				**Total**
	24-36	**37-48**	**49-60**	**61-72**	
No neuromotor impairment	62	72	46	12	192
	86.1%	80.9%	80.7%	75.0%	82.1%
Cerebral palsy	2	4	2	0	8
	2.8%	4.5%	3.5%	.0%	3.4%
Neuromuscular disease	0	2	2	0	4
	.0%	2.2%	3.5%	.0%	1.7%
Other Neuromotor impairments	5	6	4	2	17
	6.9%	6.7%	7.0%	12.5%	7.3%
Indeterminate	3	5	3	2	13
	4.2%	5.6%	5.3%	12.5%	5.6%
Total	72	89	57	16	234

Chi square value 6.22

P value: 0.904

Table 20 describes the distribution of neuro-motor impairments among age groups. It was observed that, Other NMI(6.7%- 12.5%) and INDETERMINATE(4.2-12.5%) outcomes have contributed to delayed attainment of milestones in all age groups.

In contrast to above CP and NMD were not found in the age group of 61-72 months.

However it was not statistically significant.

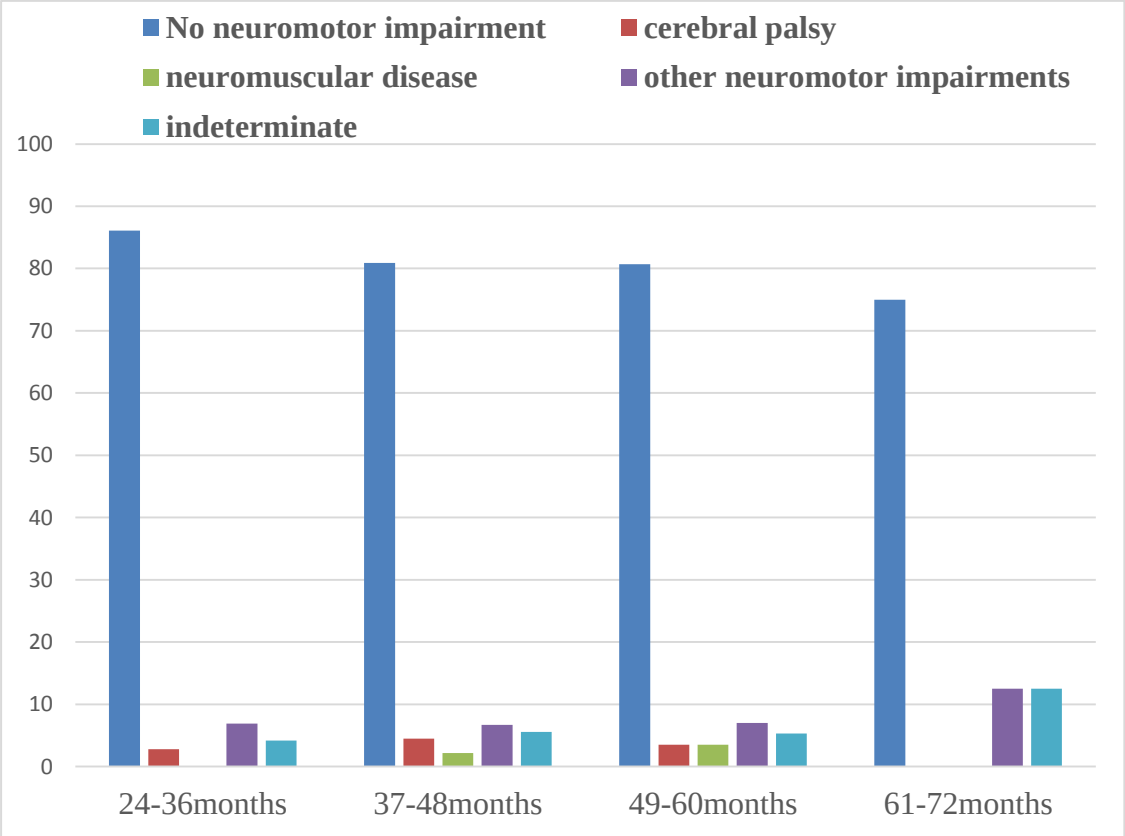


Figure 17:- Graph showing Distribution of Neuro- motor impairment in study children according to age as per INCLEN- tool

Table 21:- Distribution of Neuro- motor impairment in study children according to sex as per INCLEN-tool.

INCLEN newer tool	**Sex**		**Total**	**Chi square value**	**P value**
	Male	**Female**			
No neuromotor impairment	99	93	192	4.921	0.295
	79.2%	85.3%	82.1%		
Cerebral palsy	4	4	8		
	3.2%	3.7%	3.4%		
Neuromuscular disease	1	3	4		
	.8%	2.8%	1.7%		
Other Neuromotor impairments	12	5	17		
	9.6%	4.6%	7.3%		
Indeterminate	9	4	13		
	7.2%	3.7%	5.6%		
Total	125	109	234		
	100.0%	100.0%	100.0%		

It was observed that, neuro-motor impairments were found to have equal distribution among male and female population.

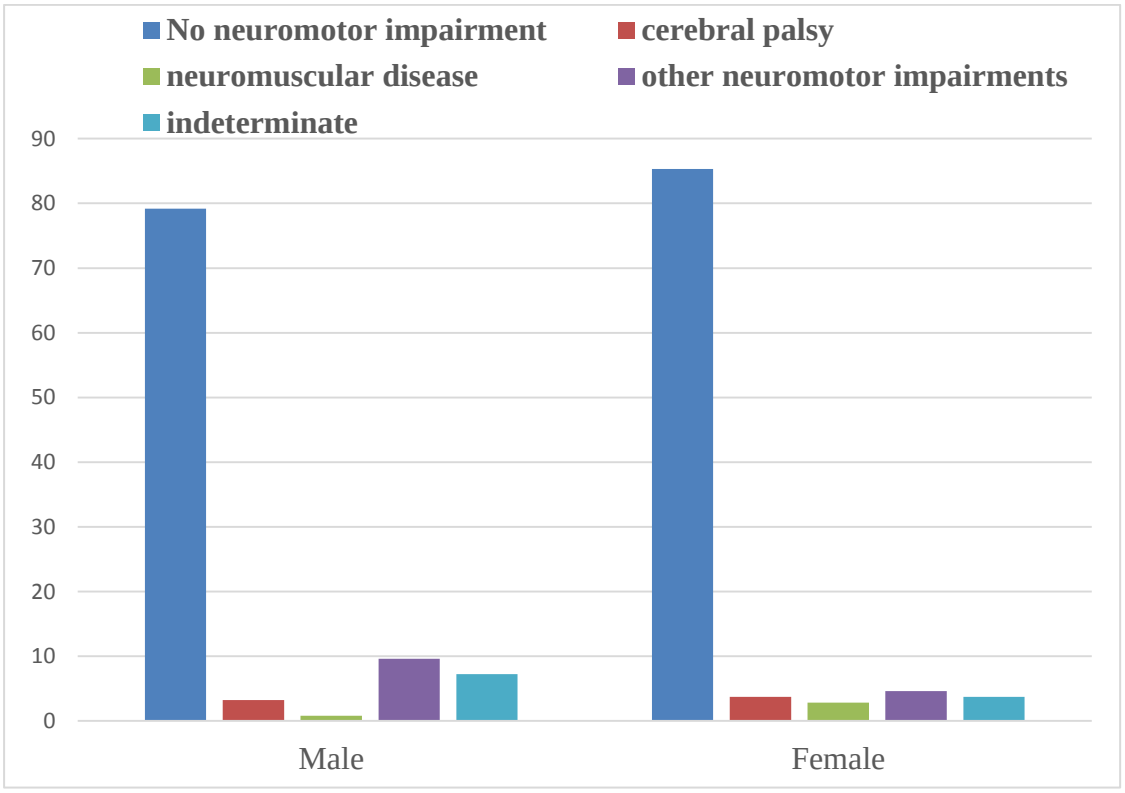


Figure 18:- Graph showing Distribution of Neuro- motor impairment in study children according to sex as per INCLEN- tool.

Table 22: Distribution of neuromotor impairments in study children according to weight for age as per INCLEN-tool.

INCLEN	Weight for age				Total	Chi square value	P value
	Moderate and severe malnutrition	Mild malnutrition	Normal	Overweight			
NO NMI	**8(66.6%)**	**61(68.5%)**	**112(91.8%)**	**11(100%)**	**192(82%)**		
NMI	**4(33.4%)**	**28(31.5%)**	**10(8.2%)**	**0**	**42(18%)**		
Total	**12(100%)**	**89(100%)**	**122(100%)**	**11(100%)**	**234(100%)**	**21.00**	**<0.001**

In table 22, association of nutrition status with neuro-motor impairments is described.

Among children with moderate and severe malnutrition, 33.4% of children had NMI, while 31.5% and 8.2% of children had NMI in mild malnutrition and normal children respectively.

None of the children had NMI among overweight.

The association between poor nutrition status and NMI was found to be statistically significant($p<0.001$).

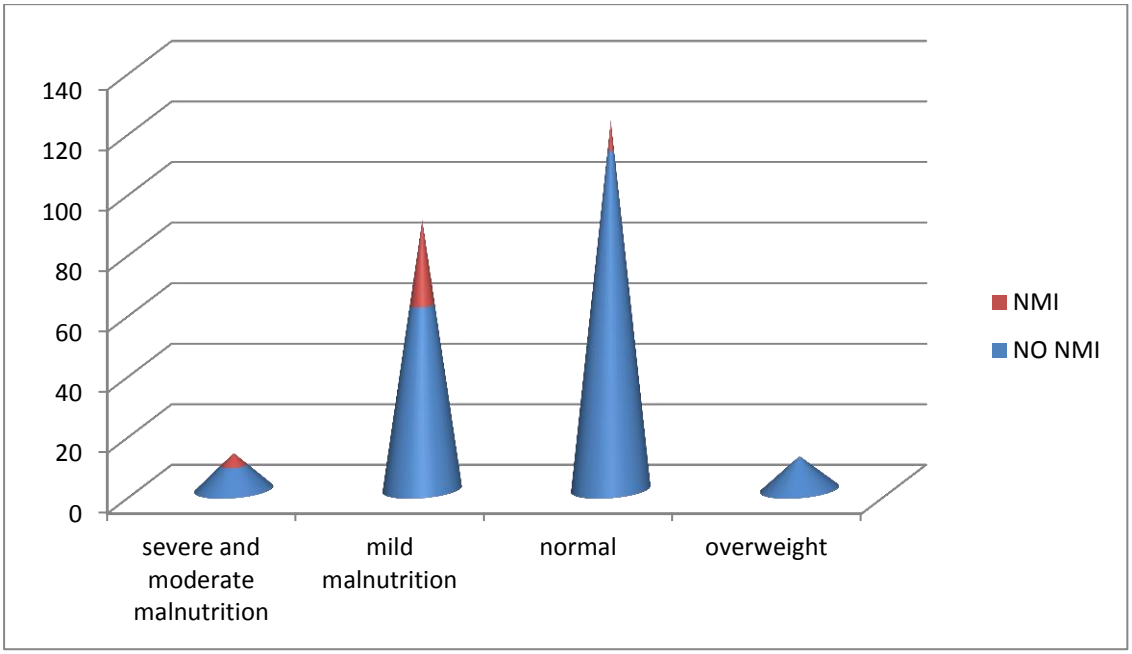


Figure 19: Distribution of neuro-motor impairments in study children according to weight for age as per INCLEN-tool.

Table 23: Distribution of neuro-motor impairments in study children according to height/length for age as per INCLEN-tool

INCLEN	Height/length for age		Total	Chi square value	P value
	Normal	Short stature			
NO NMI	**182(82.4%)**	**10(76.9%)**	**192(82%)**	**6.54**	**0.010**
NMI	**10(17.6%)**	**3(23.1%)**	**42(18%)**		
Total	**221(100%)**	**13(100%)**	**234(100%)**		

It was observed that children with short stature had more percentage of NMI (23.1%) compared to children with normal height. (Table 23)The association between NMI and short stature was found statistically significant.(p=0.01)

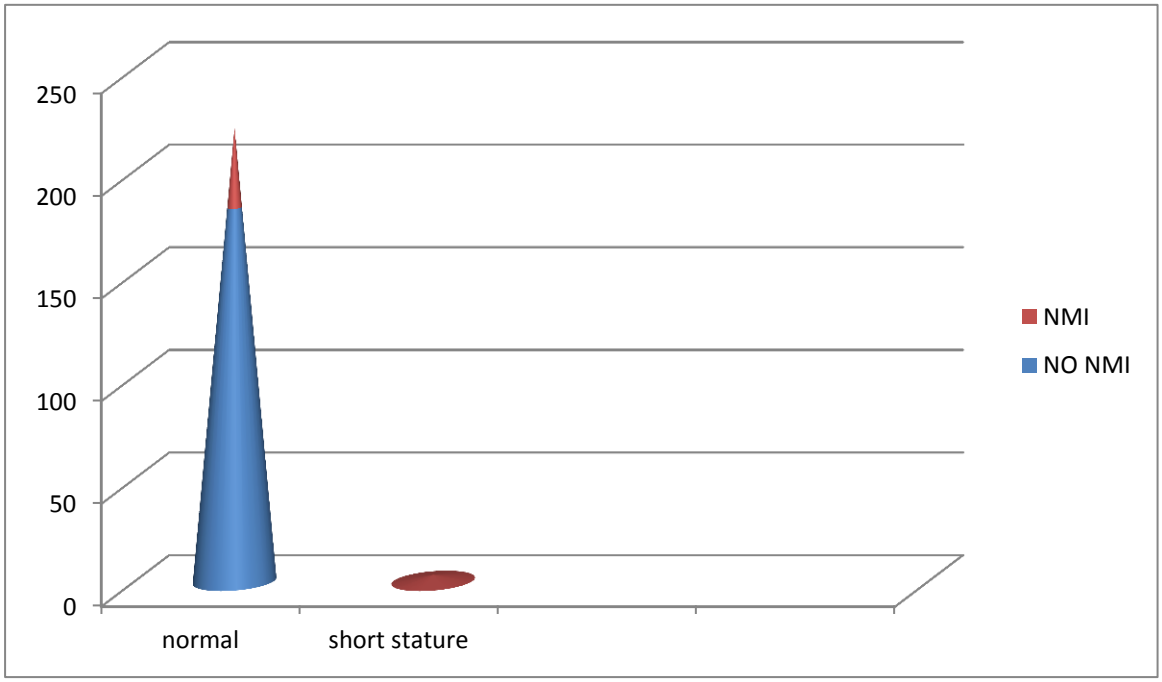


Figure 20: Distribution of neuro-motor impairments in study children according to height/length for age as per INCLEN-tool

Table 24: Distribution of neuromotor impairments in study children according to head circumference for age as per INCLEN-tool

INCLEN	Head circumference for age			Total	Chi square value	P valve
	Normal	microcephaly	Severe microcephaly			
NO NMI	189(86.3%)	3(23.1%)	0	192(82%)	35.41	<0.001
NMI	30(3.75)	10(76.9%)	2(100%)	42(18%)		
Total	219(100%)	13(100%)	2(100%)	234(100%)		

100% of children with severe microcephaly were found to have NMI.

Majority of children(76.9%) with microcephaly were found to have NMI.

Only 3.75% had NMI among children with normal head circumference.

The association between NMI and head circumference (microcephaly and severe microcephaly) was statistically significant($p<0.001$).

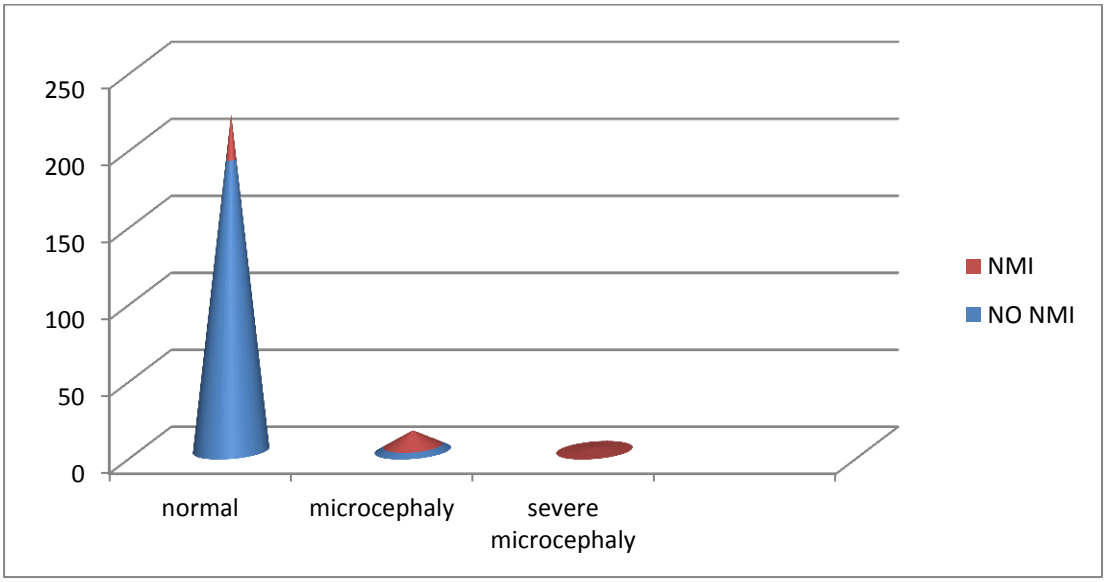


Figure 21: Distribution of neuromotor impairments in study children according to head circumference for age as per INCLEN-tool.

Table 25: Comparison of INCLEN-tool with ICMR-tool

INCLEN	**ICMR-psychosocial screening test**		
	Developmental delay present	Developmental delay absent	**Total**
Developmental delay present	17	10	27
Developmental delay absent	4	181	185
Total	21	191	212

INCLEN – tool is having

80.95% of sensitivity (CI: 58.09 -94.55),

94.76% of specificity (CI: 90.58 -97.46),

62.96% Positive predictive value(CI: 47.32 – 76.29)and

97.84% Negative predictive value (CI: 94.93 -99.09) compared to ICMR – psychosocial screening tool for screening neuro-motor impairments in children with age group of 2-6 years.

The psychometric parameter values are in acceptable standard levels.

DISCUSSION

DISCUSSION

The optimal development of the child at earlier age must be ensured. Developmental delays and disabilities are one of the reason for malnutrition, chronic ill health, psychological and familial stress[58]. Government of India has launched a number of programs to estimate the prevalence and identify the children with developmental disability at the earliest. Despite national efforts to improve developmental screening in the primary care setting, only few paediatricians use effective means to screen their patients for developmental problems[60].

Limited availability and access to paediatric neurologists, development paediatricians and therapists in low-resource countries hinders the identification of children with developmental disabilities[54].

Background demographic data of study population

Out of 234 children, more number of children (93.2%) were below 60 months. only 6.8% of children belong to the age group of 61-72 months. (Table 6)

In our study, 53.4% and 46.6% of children belong to male and female population respectively (Table 7). Similar data on gender distribution was observed in study done by **Meenakshi S et al[47],** where 55% and 45% of children belong to male and female population.

Out of 234 children, 43.3% of children were malnourished and 5.6% of children had short stature and microcephaly (Table 9,10&11). In a study carried out by **Swaroop K S et al**[61], reported that 39-75% of children were malnourished and 15.4-74% of children had short stature. We can report from our study that nutrition status of the children still deserves greater attention and need for early planning in health systems to educate families and to reduce the burden at community level.

Most of the families in our study population belong to socioeconomic class III(47.9%) and class IV(51.3%). Only 0.9% of families belong to class V as per BG Prasad socioeconomic strata classification 2016 (Table 12)

Developmental assessment using ICMR psychosocial screening tool

In the present study, out of 234 children, 3.4 – 8% of children were found to have developmental delay (Table 13). 7.7% of children had developmental delay in gross motor domain. 8.0% of children in fine motor and vision domain. 6.4% of children in hearing and language domain. 3.4% of children had developmental delay in social skills and 6.9% of children in self help skills. This study showed that less number of children had delay in social skills domain compared to that of gross and fine motor, language and hearing and self help skills domain. Similarly in the study by **Sandeep S et al**[48] in children under 3 years of age, 7.1% of children were found to have developmental delay. **Shivangi G et al**[50]observed that 6.6% of children had not attained developmental milestones in time, which is in conformity with our study. This might explain the need for assessment of development of a child at regular intervals to detect the disabilities. Further evaluation and timely intervention can be done at the earlier age.

Developmental assessment using INCLEN neuro-developmental screening tool

It is essential to screen children for neuromotor impairments clinically. In our present study out of 234 children, 42(17.9%) children were found to have neuromotor impairments (Table 19). Among 42 children, 7.3% of children have other neuromotor impairments, 5.6% of children have indeterminate results. 3.4% of children have positive screening test for cerebral palsy. Only (1.7%) of children were screened positive for neuromuscular disorders. **Silberberg D et al[51]** reported that 13% of urban area, 18% of rural area and 10% of tribal area children had neurodevelopmental disorder which was similarly noted in our study. In a study carried out by **Gulati S et al[11]** among 2-9 year old children revealed that 37.8% of children had neuromotor impairments, higher percentage of NMI can be explained owing to the more number of children being screened when compared to our study. With our study results, we would like to emphasis on incorporating neurodevelopmental screening tool in primary care setting for early identification of children with neuromotor impairment.

Developmental disability and age

ICMR tool-

In the study, children aged less than 60 months were found to have delay in attaining developmental milestones in gross motor, social skills and self help domains and all children attained developmental milestones in time in all these three domains belonging to age group of 61-72months. Equal number of children in all age groups were found to have delay(6.3-8.8%) in development in the fine motor and vision domains. Compared to above, most of the children (12.5%) belonging to age group of

61-72 months had delay in development in hearing, language and concept development domains (Table 14). Similarly, in the study by**Deepthi D et al**[49] comprising of 520 children showed delay in attaining developmental milestones in children younger than 60 months of age. The results of the study by **Sandeep S et al**[48] were in conformity with our study. In contrast to our study,**M Malik et al**[47] observed delay in attaining developmental milestones with increasing age.

INCLEN tool-

In our study, children had varied distribution of neuromotor impairments among all age groups. Cerebral palsy was not found in the age group of 61-72 months. Neuromuscular disorders were not significantly noted in the age group of 24-36 months and 61-72 months. Other NMI and indeterminate results were equally distributed among all age groups (Table 20). We could not find any association of neuromotor impairments with age. **Gulati S et al**[11] reported that, with increase in age there was decreasing trend of neuromotor impairments. Which could be explained by the probability of earlier diagnosis of children with neuromotor impairments.

From our study, more number of children aged less than 60 months were found to have developmental delay using ICMR tool compared to varied distribution of developmental delay among all age groups using INCLEN tool.

Developmental disability and sex

ICMR tool-

In our study, there was equal distribution of delay in attaining developmental milestones in all five domain among male and female population (Table 15). **Shivangi G et al**[50] reported similar results in their study. In contrast **M Malik et al**[47]

reported that percentage of boys having delay in developmental milestones were more compared to girls.

INCLEN tool-

In our study, it was noted that there is equal distribution of neuromotor impairments among male and female population (Table 21). Similar results are present in the study done by **Gulati S et al**[11]. In contrast to our study, **Varsha V et al**[52] reported that NMI were 1.5 times more prevalent in male population compared to female population.

Using both tools, we could not find any association between the sex and developmental disability in our study.

Developmental disability and nutrition status

ICMR tool-

We observed in our study that 6.7-14.6% and 16.7-33.4% of children belonging to mild and moderate to severe malnutrition group respectively were having delay in attaining developmental milestones in all five domains (Table 16). Children with normal nutrition and overweight had attained developmental milestones in time. **Vazir et al**[45] reported in their that malnourished children attained developmental milestones at a later age on assessing the psychosocial development of children aged 0-6 years . Similar results were found in a study done by **Deepthi D et al**[49]**.** Thus, indicating thatnutritional status of a child has an effect on attainment of developmental milestones.

INCLEN tool-

In our study among children with NMI, 31.5-33.4% of children with malnutrition had NMI. Only 8% of children had NMI with normal nutrition status (Table 22). To the best of our knowledge no previous studies were done to correlate nutritional status with NMI. With our study we can report that malnourished children had more percentage of neuromotor impairments. Which could be explained by neglect of children with impairments by the family members resulting in malnutrition.

We found a significant association between the nutritional status and developmental disabilities using both screening tools($p<0.005$). This might suggest children with developmental delays were neglected by family members or children with poor nutritional status attain developmental milestones at a later age.

Developmental disability and height for age

ICMR tool-

In the present study, it was observed that 15% of children with short stature had delay in development in all five domains. In comparison, only 2.7 – 7.7% of children with normal height for age had delay in development (Table 17). **SK Pradhan et al**[50] described that development of hearing, language and concept development was delayed significantly in stunted children compared to other domains. **Sandeep S et al**[48]reported that children with stunting had delay in development which is in conformity with our study. Hence children with short stature are more prone to have delay in attaining developmental milestones at appropriate age.

INCLEN tool-

In the present study 23% of children were found to have neuromotor impairments in children with short stature (Table 23). There was no supportive literature to correlate the association between short stature and neuromotor impairments.

Using both tools, more percentage of children with short stature had developmental delay.

Developmental disability and head circumference for age

ICMR tool-

In our study, 38.5-53.8% of children with microcephaly had delay in development in all five domains. 100% of children with severe microcephaly had delay in development in all five domains (Table 18). In contrast 0.5-4.6% of children with normal head circumference had delayed development. No previous studies were found to correlate attainment of developmental milestones and head circumference. From our study we could find a strong association of delay in attaining developmental milestones with children having microcephaly.

INCLEN tool-

In our study, 76.9% and 100% of children with microcephaly and severe microcephaly had NMI compared to children with normal head circumference for age (Table 24). No previous studies are found to support our finding. With our study results we could find an association between neuro-motor impairment and children with microcephlay. Hence children with microcephaly are more prone to have neuro-motor impairments.

From our study, we found a strong association between developmental disability and microcephaly in study children using two screening tests.

Comparison of INCLEN –neurodevelopmental screening tool with ICMR-psychosocial screening tool

In the current study, INCLEN tool was compared against the gold standard existing ICMR tool for motor impairments using good psychometric parameters. 17 children were found to have delay in attainment of developmental milestones using both screening tool. 4 children were found to be developmentally delayed using ICMR tool, these children were not screened positive for NMI by INCLEN tool. Similarly, 10 children were found to have delay in development using INCLEN tool, these children were not screened positive using ICMR tool. Children with delay in hearing, language, self help skills and social skills using ICMR tool and children with indeterminate results using INCLEN tool were excluded and not compared as children with only motor impairments were compared in our study (Table 25).

In our study on comparison, INCLEN tool has sensitivity of 80.95% and specificity of 94.76%. Over 94.76% of true positives were screened positive and correctly classified in to various subtypes of NMI. INCLEN tool has 62.96% of positive predictive value and 97.84% of negative predictive value.

Thus, emphasising on usage of the simple acceptable INCLEN – neuro-developmental screening tool in Anganawadi's as one of the developmental screening tool , as the tool has good acceptable sensitivity and specificity values.

CONCLUSION

CONCLUSION

- **3.4 - 8%** of children were found to have developmental delay as per ICMR screening tool in all five domains of development.
- Using INCLEN neuro-developmental screening test, **17.9%** of children had NMI. Among children with NMI, predominant had other NMI (7.3%) and INDETERMINATE(5.6%) results.
- INCLEN tool picked up more developmental disabilities compared to ICMR tool which is good for early detection and for early intervention planning of disabilities.
- In children with malnutrition(mild, moderate and severe) and microcephlay, more children were noted to have delayed attainment of developmental milestones using both ICMR and INCLEN tool. Variables from this study showed statistically significant associations between nutrition status and microcephaly with developmental delay. Educating parents regarding the importance of diet rich in calorie and protein should be reinforced in community to prevent morbidity and mortality due to malnutrition globally.
- More number of children with short stature were found to have neuro-motor impairments. From this study it was found that there was a significant association($p<0.001$) between short stature with neuro-motor impairments.
- Our study also demonstrates that INCLEN tool has **80.95% of sensitivity** and **94.76% of specificity**which is an acceptable psychometric values. Hence, INCLEN tool can be used to screen the children for neuromotor impairments. This can help in early detection of NMI and prevention of morbidities secondary to developmental disabilities worldwide.

LIMITATIONS OF THE STUDY

- Small sample size.
- INCLEN tool applied to screen the children requires trained person. Hence training of health professions makes administration of tool easier and helps in detecting NMI's at earlier age.
- Only delay in motor components of development were compared among two screening tools.
- On comparison INCLEN neurodevelopmental screening tool was found to have very wide confidence intervals (58.09-94.55 for sensitivity and 47.32-76.29 for positive predictive value) which is explained by the small sample size.

SUMMARY

SUMMARY

A cross sectional comparative study was done in Anganwadi's of Kolar town from the period of Jan 2016 –Dec 2016.

ICMR-psychosocial screening tool and INCLEN-neurodevelopmental screening tool were the tools used to assess development of children aged 2-6 years.

INCLEN tool was compared with the standardised ICMR tool in our study. A total of 234 children were included in study.

Out of 234 children, more number of children were below 60 months. Less number of children belong to the age group of 61-72 months. There was equal distribution of males and females among study population.

Out of 234 children, 43% of children were malnourished(mild, moderate and severe) and 5.6% of children had stunting as per WHO growth standard scores.

Short stature was found in 5.6% of children, others were normal.

Microcephaly and severe microcephaly was found in 5.6% and 0.9% of children respectively, others were normal.

3.4% - 8% of children had delay in development with ICMR tool. 18% of children were found to have delay in development using INCLEN tool.

Statistically significant association was found between the poor nutrition status(malnutrition and short stature) and the attainment of developmental milestones using both the tools.

Majority of children with microcephaly had delay in attainment of developmental milestones on applying both the screening tests.

On comparison of INCLEN tool with ICMR tool, INCLEN tool had **80.95% of sensitivity** and **94.76% of specificity.**

Hence INCLEN tool could be used in Anaganwadi's to screen children aged 2-6 year for delay in development**.**

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ANNEXURE

ANNEXURES

PROFORMA

INFORMATION OF THE CHILD

1. Name of the child:

2. Age (in completed months):

3. Sex: (Male -1, Female - 2)

4. Complete address of the child:

5. Informant: 1 = Mother, 2 = Father, 3 = Guardian.

6. Percapita monthly income:

7. Anthropometry: A. Weight: Kg

B. Length/Height: cm

C. Head circumference: cm

ANNEXURE I

ICMR Psychosocial developmental assessment screening tool.

GROSS MOTOR: **Age of attainment**

1. Lifts head when on stomach
2. No head lag in sitting position.
3. Sits alone
4. Crawls
5. Stands alone
6. Stands on one foot with help
7. hops on one foot
8. Walk backwards
9. Carries wooden block on head and walks 5 steps
10. Gets up from squatting position without help.

VISION AND FINE MOTOR:

11. Regards objects momentarily
12. Sustained attention of objects
13. Reaches for objects
14. Grasps objects
15. Picks up cube/pebble
16. Attempt imitation of scribble
17. Puts 3 or more cubes/pebbles into cup
18. Draws straight line in imitation
19. Draws circle in imitation

20. Draws square in imitation

21. Draws diamond line in imitation

22. Movement of thumb

23. Can close one eyelid

24. Threads one bead with nylon wire

25. Makes ball from dough/clay

26. Thumb and finger snap test

HEARING, LANGUAGE AND CONCEPT DEVELOPMENT:

27. Responds to sound

28. Manipulates bells

29. Rings bell

30. Repeats a number or word

31. Says one word

32. Identifies one object

33. Name one object

34. Enjoys looking at pictures

35. Points two parts of the body

36. Says two words together

37. Name three objects

38. Relates two objects

39. Points four parts of the body

40. Concept of big and little

41. Concept of heavy and light

42. Repeats two numbers

43. Recognizes three colours
44. Understands prepositions
45. Complete sentence
46. Understands money
47. Sings two lines of song/folk

SELF HELP SKILLS

48. Feeds self in anyway
49. Drinks from cup/glass
50. Feeds self appropriately
51. Bladder control during day
52. Bladder control during night
53. Bowel control during day
54. Bowel control during night
55. Cleans teeth
56. Washes hand
57. Washes face
58. Dresses self without help
59. Visits key places in village

SOCIAL SKILLS

60. Smiles in response
61. Vocalises in response
62. Awareness of strangers
63. Can tell his/her name
64. Can tell gender
65. Plays with other children
66. Rules of game understood

ANNEXURE II

INCLEN –neurodevelopmental screening tools:

Section I: Triage questions for Neuromotor Impairments

0: No 1: Yes 8: Not applicable

1. Does your child have difficulty in ANY of the following?

A. Sitting B. Getting up from floor

C. Standing D. Walking

E. Running

2. Did your child start performing the following activities later than children of his/her age?

A. Started sitting without support beyond his/her first birthday

B. Started walking without support beyond his/her second birthday

3. Does your child have ANY of the following?

A. Excessive tightness/ limpness of the body

B. Toe-walking

C. Abnormal posture of any limb

D. Decreased/ unequal use of any limb

E. Frequent falls

4. Does your child have difficulty in performing ANY of the following activities? (For children above 4 years age only)

A. Bathing/cleaning himself/herself

B. Toileting C. Dressing

D. Feeding self

Section 2 observations:0: No 1: Yes

5. Observe for the following when the child is walking

A. Limping

B. Unsteadiness of gait (Ataxia)

C. Toe walking

D. Waddling gait

E. Scissoring gait

F. High stepping gait

G. Unable to walk

H. Any other gait abnormality (please specify) _____

_____

6. Observe for the following when the child is standing up from floor

A. Requires assistance for standing up from floor / unable to stand

B. Gowers' sign positive

C. Any other abnormality.....

7. Observe hands and look for the following

A. Tremors

B. Unequal power of hand grip

C. Fisting of one or both hands

Please specify reason for Non-applicability of any item.

Section III: Record findings of detailed neurological assessment as codes in the respective boxes

8. Muscle power 0: Normal 1: Decreased

A. Right upper limb (Shoulder abductors & wrist extensors) -

B. Right lower limb (Hip abductors & ankle dorsiflexors)-

C. Left upper limb (Shoulder abductors & wrist extensors)-

D. Left lower limb (Hip abductors & ankle dorsiflexors)-

Overall impression: If abnormal, write the power of the abnormal side

0: Normal muscle power 1: Decreased muscle power

9. Muscle tone

0: Normal 1: Hypotonia 2: Hypertonia 3: Not applicable.

A. Tone in right upper limb (Elbow & Wrist) -

B. Tone in right lower limb (Hip adductors, knee & ankle) -

C. Tone in left upper limb (Elbow & Wrist) -

D. Tone in left lower limb (Hip adductors, knee & ankle) -

Overall impression: If abnormal, write the tone of the abnormal side

0: Normal muscle tone 1: Hypotonia 2: Hypertonia

10. Deep tendon reflexes (biceps, triceps, knee and ankle jerks)

0: Normal 1: Diminished or absent 2: Exaggerated

A. Right biceps jerk B. Left biceps jerk

C. Right triceps jerk D. Left triceps jerk

E. Right knee jerk F. Left knee jerk

G. Right ankle jerk H. Left ankle jerk

Overall impression: If abnormal, write the DTRs of the abnormal side

0: Normal DTRs 1: Diminished or absent DTRs 2: Exaggerated

11. Plantar response

0: Flexor response 1: Extensor response 2: Withdrawal / Not elicitable

A. Right side

B. Left side

Impression: Write the plantar response of the abnormal side.

12. Balance and coordination

0: Normal 1: Poor balance of trunk or limbs (Ataxia)

13. Abnormal movements

0: No abnormal movements 1: Abnormal movements

14. Interpretation

A. Neuromotor examination

0: No neuromotor dysfunction (Responses to ALL of 8-13 is "0")

1: UMN dysfunction (at least TWO out of 9-11 is "2")

2: LMN dysfunction (Response to 8 is "1", AND 9 or 10 is "1" AND 11 is not "2")

3: In coordination/ Abnormal movements (Response to 12 OR 13 is "1")

9: Indeterminate (If the findings are abnormal but not fitting in any of the above)

B. Onset of symptoms (Not for LMN dysfunction)

0: At or before 2 years of age

1: After 2 years of age or cannot be ascertained

8: Not applicable

C. Course of the child's illness

0: Static or improving 1: Progressive 8: Not applicable

D. Is there a clear spinal cord pathology resulting in impairment?

0: No 1: Yes

15. Diagnosis

0: No Neuromotor impairment (Neuro motor examination not indicated i.e. in Section 1 all questions 1 to 4 have all reponses 0 and Section 2 questions 5 to 7 have all responses is 0 OR When neuromotor examination indicated : Responses to ALL of 8-13 are "0")

1: Cerebral palsy (Response to 14 A is 1 and/or 3 AND B, C, D is "0")

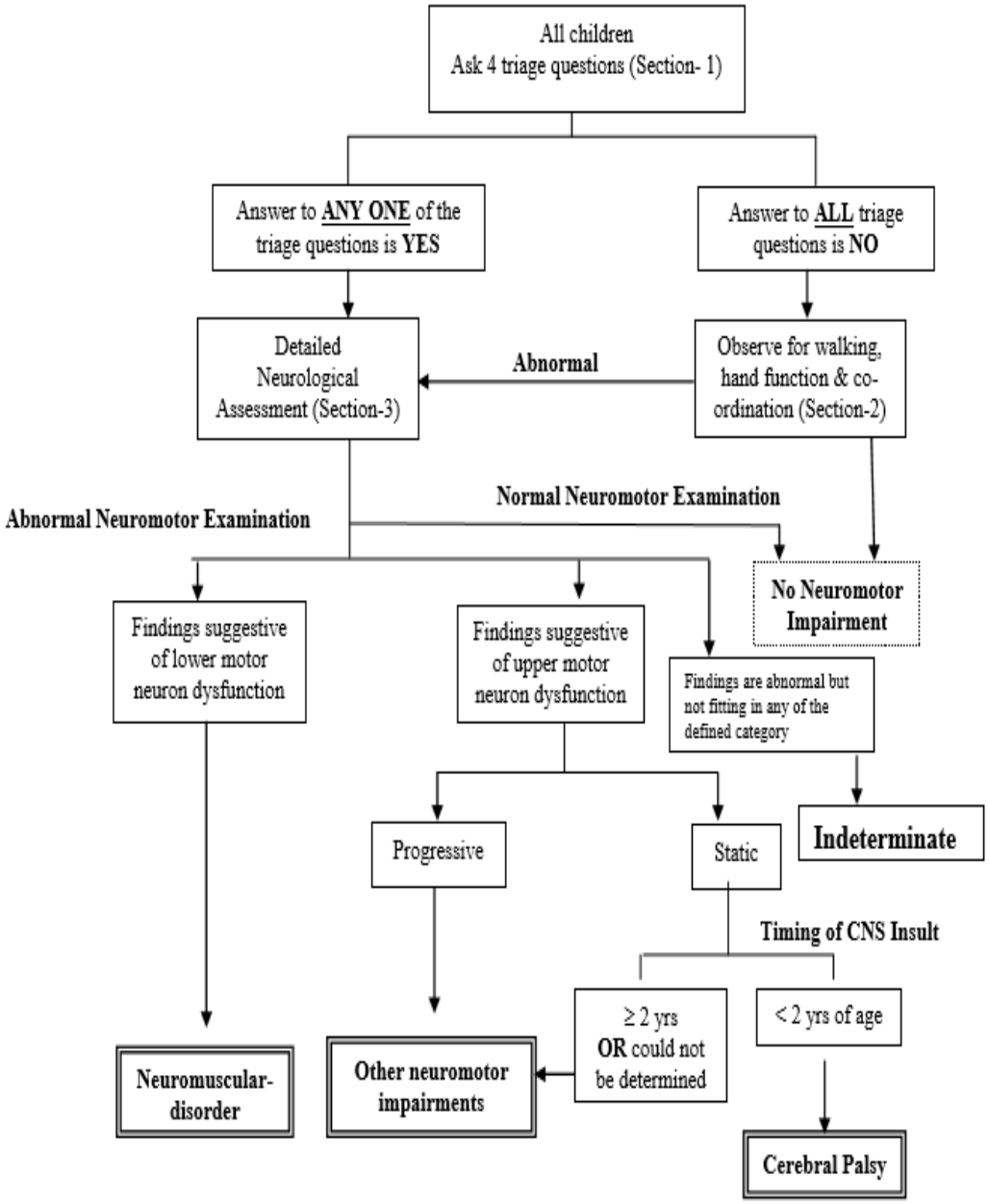
2: Neuromuscular disorder (Response to 14A is "2")

3: Other Neuromotor impairment (Response to 14A is NOT "0", but not fulfilling criteria)

4: indeterminate (response to 14A is 9)

ANNEXURE III

EVALUATION ALGORITHM FOR NEUROMOTOR IMPAIRMENTS.



CONSENT FORM

Study title: A Comparative Study On Developmental Screening in children by using INCLEN-neurodevelopmental screening tool and ICMR- Psychosocial Screening Tool.

Chief researcher/ PG guide's name: Dr. K N V Prasad.

Principal investigator: Dr.Rani. K.N

Name of the subject:

Age :

Address :

a. I have been informed in my own vernacular language the purpose of the study, the necessity of relevant steps to be carried out and photographs to be taken.

b. I understand that the medical information produced by this study will become part of institutional record and will be kept confidential by the said institute.

c. I understand that my participation is voluntary and may refuse to participate or may withdraw my consent and discontinue participation at any time without prejudice to my present or future care at this institution.

d. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

e. I confirm that _____ (chief researcher/ name of PG guide) has explained to me the purpose of research and the study procedure that I will undergo and the possible risks and discomforts that I may experience, in my own language. I hereby agree to give valid consent to participate as a subject in this research project.

Participant's parent signature :

Date:

I have explained to _____ (subject) the purpose of the research, the possible risk and benefits to the best of my ability.

INFORMATION SHEET

I Dr. Rani.K.N, Post Graduate in Department of Pediatrics, conducting a study on " **A Comparative Study On Developmental Screening in children by using INCLEN- neurodevelopmental screening tool and ICMR- Psychosocial Screening Tool."** Which is a cross sectional, comparative study to assess the developmental status of the Anganwadi children. This study would be beneficial to children who found to have developmental disability, in time intervention can be made and treated. There will not be any additional expenditure other than routine care incurred because of this study.Personal information will not be revealed and the scientific data obtained through the study will be communicated to other Pediatricians.

(Principle investigator)

DATE:

KEY TO MASTER CHART

PART -1 :

A = NAME

B = AGE

C = SEX

D = GROSS MOTOR MILESTONES

E = VISION AND FINE MOTOR MILESTONES

F = HEARING, LANGUAGE AND CONCEPT DEVELOPMENT

G = SOCIAL SKILLS

H = SELF HELP SKILLS

I = INCLEN NEWER TOOL

J = WEIGHT FOR AGE

K = HEIGHT/ LENGTH FOR AGE

L = HEAD CIRCUMFERENCE FOR AGE

M = SOCIO ECONOMIC STRATA AS PER BG PRASAD CLASSIFICATION

PART – 2

AGE OF THE CHILD:

24MONTHS- 36 MONTHS = 137 MONTHS- 48 MONTHS = 2

49 MONTHS- 60 MONTHS = 361 MONTHS – 72 MONTHS = 4

SEX OF THE CHILD:

MALE = 1 FEMALE = 2

DEVELOPMENTAL SCREENING BY ICMR- PSYCHOSOCIAL SCREENING TOOL:

GROSS MOTOR MILESTONES:

IN TIME = 1 DELAYED = 2

VISION AND FINE MOTOR MILESTONES:

IN TIME = 1 DELAYED = 2

HEARING, LANGUAGE AND CONCEPT DEVELOPMENT:

IN TIME = 1 DELAYED = 2

SOCIAL SKLLS:

IN TIME = 1 DELAYED = 2

SELF HELP SKILLS:

IN TIME = 1 DELAYED = 2

DEVELOPMENTAL SCREENING BY INCLEN - A NEWER TOOL

NO NEUROMOTOR IMPAIRMENT = 1

CEREBRAL PALSY = 2

NEUROMUSCULAR DISEASE = 3

OTHER NEUROMOTOR IMPAIRMENTS = 4

INDETERMINATE = 5.

WEIGHT FOR AGE (AS PER WHO CLASSIFICATION)

SEVERE MALNUTRITION = 1 MODERATE MALNUTRITION = 2

MILD MALNUTRITION = 3 NORMAL = 4

OVERWEIGHT = 5 OBESITY = 6

HEIGHT FOR AGE:

APPROPRIATE FOR AGE = 1 SHORT STATURE = 2

HEAD CIRCUMFERENCE FOR AGE

APPROPRIATE FOR AGE = 1

MICROCEPHALY = 2 SEVERE MICROCEPHALY = 3

SOCIO ECONOMIC STRATA AS PER BG PRASAD CLASSIFICATION:

CLASS I = 1 CLASS II = 2 CLASS III = 3

CLASS IV = 4 CLASS V = 5

MASTER CHART

A	B	C	D	E	F	G	H	I	J	K	L	M
Adarsh	1	1	1	1	1	1	1	1	4	1	1	3
Shiv	1	1	1	2	1	2	1	4	3	1	1	4
Krutashree	2	2	2	2	2	2	2	2	3	1	2	4
Murali	2	1	1	1	2	1	1	5	4	1	1	3
Sundhari	1	2	1	1	1	1	1	5	4	1	1	4
Jeeva	3	1	1	1	1	1	1	1	4	1	1	4
Vinod	1	1	1	1	1	1	1	1	5	1	1	3
Mounashre	2	2	1	1	1	1	1	1	3	1	1	3
Ashwini	1	2	1	1	1	1	1	1	4	1	1	3
Ajay	2	1	1	1	1	1	1	1	2	1	1	3
Lavanya	1	2	1	1	1	1	1	1	4	1	1	3
Shilpa	2	2	1	1	1	1	1	1	4	1	1	3
Nandu	1	1	1	2	1	1	2	5	2	1	1	4
Akbar	3	1	1	1	1	1	1	4	3	2	1	3
Lakshmidev	2	2	1	1	1	1	1	1	2	1	1	4
Arun	1	1	1	1	1	1	1	1	4	1	1	3
Alfiya	2	2	1	1	1	1	1	1	3	1	1	4
Saif	1	1	2	2	1	1	1	4	3	1	1	3
Govind	3	1	1	1	1	1	1	1	4	1	1	4
Imran	2	1	2	2	2	2	2	2	2	1	3	3
Hemavati	3	2	1	1	1	1	1	1	4	1	1	4
Bavish	2	1	2	2	2	1	1	4	3	1	1	4
Ayesha	1	2	1	1	1	1	1	1	4	1	1	3
Vidvath	2	1	1	1	1	1	1	1	3	1	1	3
Indra	3	1	1	1	1	1	1	1	3	2	1	3
Yasmeen	2	2	2	2	1	1	2	3	3	1	1	3
Barish	2	1	1	1	1	1	1	1	5	1	1	3
Siddharth	3	1	1	1	1	1	1	1	4	1	1	3
Sham	2	1	1	1	1	1	1	1	3	1	1	4
Harish	2	1	1	1	1	1	1	1	4	1	1	3
Lahari	1	2	1	1	1	1	1	1	3	1	1	4
Dakshayini	3	2	1	1	1	1	1	1	2	2	1	4

Rashmi	2	2	1	1	1	1	1	4	4	1	1	4
Raj	1	1	1	1	2	1	1	5	3	1	1	3
Rahul	1	1	1	1	1	1	1	1	4	1	1	4
Naveen	1	1	1	1	1	1	1	1	4	1	1	4
Reshma	2	2	1	1	1	1	1	1	4	1	1	4
Likith	1	1	2	2	1	1	2	4	1	1	2	3
Mustak	2	1	2	1	1	1	1	5	3	1	1	3
Umar	2	1	1	1	1	1	1	1	4	1	1	4
Kashif	2	1	1	1	1	1	1	1	4	1	1	3
Atif	2	1	1	1	1	1	1	1	3	1	1	3
Arjun	1	1	1	1	1	1	1	1	4	1	1	4
Pradeep	1	1	1	1	1	1	1	1	5	1	1	4
Rukmani	1	2	1	1	1	1	1	1	3	1	1	3
Akash	2	1	1	1	1	1	1	1	4	1	1	3
Shwetha	2	2	1	1	1	1	1	4	3	1	1	3
Sharadha	1	2	1	1	1	1	1	1	3	1	1	3
Vinod	3	1	1	1	1	1	1	1	4	1	1	3
Gyan	3	1	1	1	1	1	1	1	3	1	1	4
Gayathri	3	2	1	1	1	1	1	1	3	1	1	3
Geeta	4	2	1	1	1	1	1	1	3	1	1	3
Gowri	4	2	1	1	1	1	1	1	3	2	1	4
Basheer	4	1	1	2	2	1	2	5	3	1	1	3
Guna	3	2	1	1	1	1	1	1	3	1	1	3
Shobitha	3	2	1	1	1	1	1	1	2	1	1	3
Yashwanth	4	2	1	1	1	1	1	1	3	1	1	3
Swati	4	2	1	1	1	1	1	1	4	1	1	3
Yeshwant	3	1	1	1	1	1	1	1	4	1	1	3
Sangita	3	2	2	2	1	1	2	3	3	1	1	4
Sandeep	1	1	1	1	1	1	1	1	4	1	1	3
Manjunath	4	1	1	1	1	1	1	1	6	1	1	4
Pruthvi	2	2	1	1	1	1	1	1	3	1	1	3
Bhavani	2	2	1	1	1	1	1	1	3	1	1	4
Bhanu	4	2	1	1	1	1	1	1	3	1	1	3

Pallavi	4	2	1	1	1	1	1	1	3	1	1	3
Shivaraj	3	1	1	1	1	1	1	1	4	1	1	4
Venkat	3	1	1	1	2	1	1	5	3	1	1	3
Manasa	4	2	1	1	1	1	1	1	3	1	1	4
Charan	1	1	1	1	1	1	1	1	5	1	1	4
Thomson	4	1	1	1	1	1	1	4	3	1	2	3
Ujwala	4	2	1	1	1	1	1	1	4	1	1	3
Manjunath	4	1	1	1	1	1	1	4	3	1	2	4
Manjula	4	2	1	1	1	1	1	1	3	1	1	4
Shree	4	2	1	1	2	1	1	5	3	1	1	4
Lalita	4	2	1	1	1	1	1	1	4	1	1	4
Shalini	4	2	1	1	1	1	1	1	4	1	1	3
Kaif	3	1	1	1	1	1	1	1	3	1	1	3
Jyoti	3	2	1	1	1	1	1	1	4	1	1	3
Geeta	3	2	1	1	1	1	1	1	3	1	1	4
Chandushr	3	2	2	2	2	2	2	2	2	2	3	4
Asha	3	2	1	1	1	1	1	1	4	1	1	4
Yugan	3	1	1	1	1	1	1	4	3	1	1	4
Sulochana	3	2	1	1	1	1	1	1	3	1	1	3
Nitin	3	1	1	1	1	1	1	1	3	1	1	3
Shaikafree	3	1	1	1	1	1	1	1	5	2	1	3
Jeevika	3	2	1	1	1	1	1	1	3	1	1	4
Sahil	3	1	2	2	2	2	2	2	3	1	2	3
Sowmya	3	2	1	1	1	1	1	1	3	1	1	3
Premesh	3	1	1	1	1	1	1	1	6	1	1	3
Nishkala	3	2	1	1	1	1	1	1	3	1	1	4
Gagan	3	1	1	1	1	1	1	1	3	1	1	4
Rakshith	3	1	1	1	1	1	1	4	3	1	1	4
Pranati	3	2	1	1	1	1	1	1	4	1	1	3
Gagan	3	1	1	1	1	1	1	1	4	1	1	4
Yadav	3	1	1	1	1	1	1	1	4	1	1	4
Yashoda	2	2	1	1	1	1	1	5	3	1	1	3
Renuka	2	2	1	1	1	1	1	1	4	1	1	3

Sanvith	2	1	1	1	1	1	1	1	4	1	1	3
Yasir	2	1	1	1	1	1	1	1	3	1	1	4
Savita	1	2	1	1	1	1	1	1	3	1	1	4
Padma	1	2	1	1	1	1	1	1	4	1	1	4
Mahendra	1	1	1	1	1	1	1	1	4	1	1	4
Poorvik	1	1	1	1	1	1	1	1	1	1	1	4
Pavan	1	1	1	1	1	1	1	4	3	1	2	4
Pavithra	1	2	1	1	1	1	1	1	5	1	1	3
Roja	1	2	1	1	1	1	1	1	4	1	1	3
Jagadish	1	1	1	1	1	1	1	1	3	1	1	3
Chandushr	1	1	1	1	1	1	1	4	4	1	1	4
Mahesh	1	1	1	1	1	1	1	1	4	1	1	3
Srinivas	3	1	1	1	1	1	1	1	3	1	1	3
Suri	3	1	1	1	1	1	1	1	3	1	1	4
Shilpa	3	2	1	1	1	1	1	1	4	1	1	3
Shiv	3	1	1	1	1	1	1	1	3	2	1	3
Sanjay	3	1	1	1	1	1	1	1	3	1	1	4
Sanvith	3	2	2	2	1	1	2	4	3	1	1	3
Vikram	2	1	1	1	1	1	1	1	3	1	1	3
Vikas	2	1	1	1	1	1	1	1	4	1	1	4
Chandini	2	2	1	1	1	1	1	1	2	1	1	3
Vinuta	2	2	1	1	1	1		1	3	1	2	4
Vasavi	2	2	1	1	1	1	1	1	3	1	1	3
Varshit	3	1	2	1	1	1	2	3	3	1	1	4
Harsha	2	1	1	1	1	1	1	1	5	1	1	4
Harshika	1	2	1	1	1	1	1	1	3	1	1	4
Huimanshu	2	1	1	1	1	1	1	1	4	1	1	4
Lahari	1	2	1	1	1	1	1	1	4	1	1	4
Likith	2	1	1	1	1	1	1	1	3	1	1	4
Lakshmidev	3	2	1	1	1	1	1	1	3	1	1	4
Saroja	2	2	1	1	1	1	1	1	3	1	1	3
Sangita	2	2	1	1	1	1	1	4	3	1	1	4
Shravan	2	1	2	2	2	2	2	2	3	1	2	3

Shivraj	2	1	1	1	1	1	1	1	3	1	1	3
Sameera	3	2	1	1	1	1	1	1	4	1	1	4
Sandeep	2	1	1	1	1	1	1	1	2	1	1	4
Umar	2	1	1	1	1	1	1	1	3	1	1	4
Farooq	2	1	1	1	1	1	1	1	2	1	1	4
Atif	2	1	1	1	1	1	1	1	4	1	1	3
Shankar	2	1	1	1	1	1	1	1	4	1	1	4
Prabhu	2	1	1	1	1	1	1	5	4	1	1	4
Bhavesh	3	1	1	1	1	1	1	1	4	1	1	4
Manasa	1	2	1	1	1	1	1	1	3	1	1	4
Nagamani	2	2	1	1	1	1	1	1	3	1	1	4
Anusha	2	2	2	2	1	1	2	3	4	1	1	3
Thilak	2	1	1	1	1	1	1	1	4	1	1	4
Akash	2	1	1	1	1	1	1	1	3	2	1	4
Noora	1	2	1	1	1	1	1	1	4	1	1	3
Ayesha	2	2	1	1	1	1	1	1	4	1	1	4
Asma	2	2	1	1	1	1	1	1	4	1	1	4
Harshak	2	1	1	1	1	1	1	1	4	1	1	3
Poojita	2	2	1	1	1	1	1	1	4	1	1	4
Wasim	3	1	2	2	1	1	2	5	4	1	1	4
Chethan	2	1	1	1	1	1	1	1	4	1	1	4
Sadath	1	1	1	1	1	1	1	1	3	1	1	4
Shoba	2	2	1	1	1	1	1	1	4	1	1	4
Shyla	3	2	1	1	1	1	1	1	4	2	1	4
Kahaseer	2	1	2	2	2	2	2	2	3	1	2	4
Suresh	2	1	1	1	1	1	1	1	4	1	1	4
Bhavya	2	2	1	1	1	1	1	1	4	1	1	3
Surekha	1	2	1	1	1	1	1	1	3	1	1	4
Srikanth	3	1	1	1	1	1	1	1	4	1	1	3
Nitish	2	1	1	1	1	1	1	1	5	1	1	4
Mamata	2	2	1	1	1	1	1	4	4	1	1	4
Sowmya	2	2	1	1	1	1	1	1	4	1	1	4
Samarth	1	1	1	1	1	1	1	1	4	1	1	4

Salma	2	2	1	1	1	1	1	1	3	1	1	3
Lalita	2	1	1	1	1	1	1	1	4	1	1	4
Leela	3	2	1	1	2	1	1	5	4	1	1	4
Zaibar	2	1	1	1	1	1	1	1	3	1	1	4
Thanuja	1	2	1	1	1	1	1	1	4	1	1	5
Naveen	1	1	1	1	1	1	1	1	4	1	1	4
Sahana	2	2	1	1	1	1	1	1	4	1	1	4
Sailesh	2	1	1	1	1	1	1	1	5	1	1	4
Mytri	3	2	1	1	1	1	1	1	4	1	1	3
Saifulla	2	1	1	1	1	1	1	4	3	1	1	4
Sanket	1	1	1	1	1	1	1	1	4	1	1	4
Sunil	1	1	1	1	1	1	1	1	4	1	1	4
Rashmi	2	2	1	1	1	1	1	1	3	1	1	3
Sukruti	1	2	1	1	1	1	1	1	4	1	1	4
Dhanush	1	1	1	1	1	1	1	1	4	1	1	3
Ambarish	1	1	1	1	1	1	1	1	4	1	1	4
Raksha	2	2	1	1	1	1	1	1	4	1	1	4
Teju	2	2	1	1	1	1	1	1	4	1	1	3
Tejas	1	1	1	1	1	1	1	1	4	1	1	3
Nikita	1	2	1	1	1	1	1	1	4	1	1	4
Gokul	1	1	1	1	1	1	1	1	4	1	1	3
Sharat	2	1	1	1	1	1	1	5	4	1	1	3
Saifulla	1	1	1	1	1	1	1	1	4	1	1	4
Asha	2	2	1	1	1	1	1	1	4	1	1	4
Padma	1	2	1	1	1	1	1	1	4	1	1	3
Neela	3	2	1	1	1	1	1	1	3	1	1	3
Sanaulla	2	1	1	1	1	1	1	1	3	1	1	4
Vinay	1	1	1	1	1	1	1	1	4	1	1	3
Rani	1	2	1	1	1	1	1	1	4	1	1	3
Rahul	2	1	1	1	1	1	1	1	4	1	1	3
Raj	3	1	1	1	1	1	1	1	4	2	1	4
Deepa	2	2	1	1	1	1	1	1	3	1	1	4
Almas	1	1	1	1	1	1	1	1	4	2	1	4

Ayesha	2	2	1	1	1	1	1	1	4	1	1	3
Asma	1	2	2	2	2	2	2	2	3	2	2	5
Arif	2	1	1	1	1	1	1	1	4	1	1	4
Harshitha	1	2	1	1	1	1	1	1	4	1	1	4
Zeeshan	2	1	1	1	1	1	1	1	4	1	1	3
Sahil	1	1	1	1	1	1	1	1	3	1	1	4
Zabeer	1	1	1	1	1	1	1	1	4	1	1	4
Nirupa	1	2	1	1	1	1	1	1	3	1	1	4
Sanju	3	1	1	1	1	1	1	1	4	1	2	4
Lakshmidev	1	2	1	1	1	1	1	1	3	1	1	4
Sanjana	2	2	1	1	1	1	1	1	4	1	1	4
Shashank	2	1	1	1	1	1	1	1	4	1	1	4
Arif	3	1	1	1	1	1	1	1	4	1	1	3
Nagamani	2	2	1	1	1	1	1	1	4	1	1	3
Jeevit	3	1	1	1	1	1	1	1	4	1	1	3
Sham	1	1	1	1	1	1	1	1	4	1	1	3
Asma	2	2	1	1	1	1	1	1	4	1	1	3
Sahana	1	2	1	1	1	1	1	1	4	1	1	3
Swati	1	2	1	1	1	1	1	1	3	1	1	4
Supreetha	2	2	1	1	1	1	1	1	4	1	1	3
Satwik	1	1	1	1	1	1	1	1	3	1	1	4
Rohan	1	1	1	1	1	1	1	1	4	1	2	3
Bhanumati	3	2	1	1	1	1	1	1	4	1	1	3
Bhavesh	1	1	1	1	1	1	1	1	4	1	1	3
Reshma	2	2	1	1	1	1	1	1	4	1	1	3
Ajay	1	1	1	1	1	1	1	1	4	1	1	3
Akash	1	1	1	1	1	1	1	1	4	2	1	3
Anand	1	1	1	1	1	1	1	1	4	1	1	3
Annesh	2	1	1	1	1	1	1	1	4	1	1	3
Varsha	2	2	1	1	1	1	1	1	4	1	1	3
Vijaya	1	2	2	2	2	1	1	2	3	1	2	4
Nandu	1	1	1	1	1	1	1	1	4	1	1	4
Navya	1	2	1	1	1	1	1	1	4	1	1	3

Naveena	2	2	1	1	1	1	1	1	4	1	1	3
Jyoti	1	2	1	1	1	1	1	1	4	1	1	3
Pavitra	3	2	1	1	1	1	1	1	4	1	1	4
Vinay	2	1	1	1	1	1	1	1	4	1	1	3