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Evaluation of the Nutritional Status of Toddlers and Preschool Children and Its Effect on Developmental Outcomes.

1Dr Harini .S, 2Dr.Jaishree V

1MD Paediatrics(3rd year postgraduate),Department of Paediatrics , Chettinad Hospital and Research Institute,Chettinad Academy of Research and Education, Kelambakkam-603103,Tamil Nadu,India

2MD,Professor and Head of Department , Department of Paediatrics , Chettinad Hospital and Research Institute,Chettinad Academy of Research and Education, Kelambakkam-603103,Tamil Nadu,India

Corresponding author

Name: **Dr.Sunitha R**, MD,Associate Professor ,Department of Paediatrics , Chettinad Hospital and Research Institute,Chettinad Academy of Research and Education, Kelambakkam-603103,Tamil Nadu,India

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KEYWORDS

Toddlers, Preschool Children, Effect on Developmental

ABSTRACT:

Background:

Childhood malnutrition remains a pressing issue in low- and middle-income countries, with India showing high rates of stunting, wasting, and underweight in children under five. Poor nutritional status in early life is strongly associated with adverse developmental outcomes including delayed motor, language, cognitive, and social skills. Despite various national health programs, the intersection of nutrition and developmental outcomes in toddlers and preschoolers requires further exploration.

Objectives:

1. To evaluate the nutritional status of children aged 6 months to 5 years.
2. To assess the association between nutritional status and developmental outcomes.

Methodology:

This was a cross-sectional study conducted from August to December 2024 at the Outpatient Unit, Department of Paediatrics, Chettinad Hospital and Research Institute, Kelambakkam. A total of 180 children aged 6 months to 5 years were enrolled using convenient sampling. Anthropometric measurements (weight-for-age, height-for-age, BMI, MUAC, head circumference) were taken and plotted on WHO growth charts. Children were classified into categories of nutritional status (normal, MAM, SAM, underweight, thinness, obesity). Development was assessed using the Trivandrum Developmental Screening Chart (TDSC) across gross motor, fine motor, language, and social domains.

Results:

Among children aged 0–3 years (n=92), 79.3% had normal nutritional status, while 13% had MAM, and 3.3% had chronic malnutrition. 86.2% showed no gross motor delay, but 75.8% had language delay. Social milestone delay was present in 49.1%. In children aged 3–6 years (n=88), 61.4% had normal nutrition, while 10.2% had MAM. Developmental delays were noted in 21.5% (gross motor), 38.8% (fine motor), 40.5% (language), and 36% (social) domains. Notably, children with chronic malnutrition exhibited delays in fine motor (83.3%), language (85.3%), and social (71.4%) milestones. Interestingly, even children with normal anthropometry exhibited delays, indicating the influence of socio-economic and environmental factors.

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INTRODUCTION:

According to NFHS-5 survey prevalence of children below 5 years of age who were stunted (height-for-age),children under 5 years who were wasted (weight-for-height),children under 5 years who were severely wasted (weight-for-height),children under 5 years who were underweight (weight-for-age) children under 5 years who were overweight (weight-for-height) were 34.5%,19.3%,7.7%,32.1%&3.4% respectively. The consequences of undernutrition in India are indeed dire, particularly for children's development. It stunts their physical growth, makes them more vulnerable to diseases throughout childhood and into adulthood, and hampers cognitive and motor development(1).This, in turn, limits educational achievement, productivity, and perpetuates the cycle of poverty. Since India falls under low- and middle-income countries. Factors like poor stimulation at home, chronic undernutrition (stunting), and deficiencies in iron and iodine are are other risk factors affecting their educational and adult outcomes(2).Professionals advocate for large-scale programs integrating health, nutrition, and child development promotion, but there's limited data on the feasibility and outcomes of such integrated interventions. Research in future period is needed to assess the benefits and potential drawbacks of these approaches. Addressing these issues early is crucial for breaking the cycle of malnutrition and its long-term impacts.

The early childhood period is well recognised as a sensitive time window for the optimal growth, development and well-being of children . During this phase, therelationships between cognitive development, motor development, language development, future educational and health outcomes are crucial and are considered predictors of lifelong and academic achievement, wealth and quality of life . On the other hand, early developmental deficits have been linked to an increased risk of chronic diseases in laterlife , unemployment and low socioeconomic positioning in adulthood .
Neurodevelopment is influenced by a number of factors ranging from gestational age at birth to biological, socio-economic and psychosocial environment. Nevertheless, there are important and controllable environmental factors that can profoundly influence earlybrain development(3) . Toddlers with stunting will have a different level of intelligence than toddlers in general; this makes children susceptible to various diseases and is at risk of decreasing productivity in the future. The impact will expand even further to hamper economic growth and increase poverty. Stunting indicates a disturbance in the body's organs, where the brain is one of the organs that is most quickly damaged when a child experiences nutritional disorders.Damage to the brain certainly affects children not only from a motoric aspect butalso from a psychosocial aspect. Children with stunting will easily experience the feeling as if they are younger than their age and the risk of getting bullied, ridiculed, and disturbed during adolescence, where height can affect their self-image and self-efficacy when interacting with peers. Impacts of stunting can lead to various disturbances in children, including psychosocial problems in later stages of their development. According to the World Health Organization (WHO), stunting can cause developmental delays in childrendue to growth delays. One noticeable effect of this delay is the cognitive development delay, which can manifest in a child's academic performance. Cognitive abilities such as critical thinking, problem-solving, and memory may be compromised or hindered. Research suggests poor nutrition and growth early in life are associated with poorer performance on tests of motor development and cognitive functioning, as well as deficits in social skills, attention, learning, andeducational achievement.

Malnutrition is characterized by an imbalance between a person’s nutrient requirements and their nutrient consumption, and includes conditions of overnutrition and undernutrition . Undernutrition is caused by an inadequate intake of energy, protein, or vitamins and minerals , and is a present-day global problem hindering the development of young children . For young children, undernutrition can cause emaciation, stunting and wasting, or various micronutrient deficiencies . Worldwide, 149 million children are stunted and 45 million are wasted . Inadequate protein and energy intake in childhood is directly associated with reduced growth, and is indicative of several psychosocial problems later in life . Undernourished children also exhibit impaired development and decreased functional capacity . Paediatric undernutrition is characterized by a lack of adequate weight gain, low weight per height, or low weight per length, and is a direct contributor to impaired cognitive skills . The first five years of children’s life is an important period for their growth and development

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since the basic milestone that occurs during the first five years will determine, the next children's development. As itis discovered that the first two years is a golden period since optimization of growth and development occurs during this stage (Risma, 2009). Motor development is one element of children developments. Possessing fine and gross motor skills is important for children's growth and independence. Motor formation and developmentstart since the fetal stage within a mother's womb. During the 24 weeks up to 34 weeks of gestational age is neurological maturation of subcorticospinal system and the enhancement of myelinated fibers in the spine that affectsfetal motor development in the future (Ruike*et al.,* 2015). Infants with low birth weight (LBW) are at risk for numerous complication such as respiratory disorder, sleep apnea, heart problems, lungs problems, jaundice, anemia, chronic lungs problem, infections, and disorders of childhood growth and development .Motor development of children under five years old is greatly affected by nutrition, health status, and movement practice treatment which are in accordance with development stages. Anatomically, development will occur within individual's body which proportionally changes along withthe children's age. Insufficient nutritional status will hamper the growth and development which an individual undergoes, as the result the proportion of body structure does not fit the age and eventually willimplicate the development of other aspects (Mahendra dan Saputra, 2006). Optimal nutrition during early childhood is critical for cognitive development, forming the foundation for future learning, behavior, and health outcomes. Cognitive development encompasses the acquisition of skills such as language, memory, attention, and problem-solving, which are profoundly influenced by nutrition during the first few years of life (Sharma, 2022; Sharma &Budhathoki, 2023). Studies have found a link between dietary intake and various cognitive and developmental outcomes, suggesting that early care and stimulation can significantly impact cognitive skills and educational success (Tsan et al., 2021; Gutierrez et al., 2021). Emerging evidence suggests that inadequate nutrition, including deficiencies in essential macronutrients and micronutrients, can impair brain structure and function, hindering cognitive potential. These effects are particularly significant in low- and middle-income countries (LMICs), where malnutrition remains a pervasive issue. The pre-school period is characterized by intensivegrowth and development of a humanbody. Child development is healthy if it occurs correctly and isageadequate in all spheres: physical, motor, emotional, cognitive and social. Any dysfunctions in one of the spheres may adversely affect the others . Diet and lifestyle affect the development processes. These factors also shape current behavior and future habits of a person and affect their health status not only in childhood, but also in adulthood. A child's diet should be based on healthy nutrition principles and adapted to their age-adequate energy and nutrient requirements. Home (25% of total daily requirement)and kindergarten (75% of total daily requirement) nutrition should complement each other and together form a balanced daily food ration. The development process is also supported by non-nutritional factors,such as adequate physical activity, optimal sleep duration and avoidance of stress .

BACKGROUND AND RATIONALE :

AIMS & OBJECTIVE :

1. To evaluate the nutritional status of the child between 6 months -5 years of age
2. To assess the association between nutrition and developmental outcome

Methodology:

1.Study design - Cross sectional study

2.Study Setting -Out patient Unit, Department of Paediatrics, Chettinad hospital and research institute, Kelambakkam

3. Source Population: Children presenting to OPD of Chettinad Hospital & Research Institute

4.Study Population: Children between 6 months-5 years of age

Study period - August 2024 -December 2024

5.Selection Criteria:

1.Inclusion criteria:

1.Children whose anthropological interpretation falls under normal , moderate acute malnutrition, severe acute malnutrition, overweight and obesity

2.Children who gave parental consent/ assent to participate in the study

2.Exclusion criteria:

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1. Children with Congenital and genetic disorders
2. Children with confirmed cases of malignancy
3. Children with Chronic disorders and primary immunodeficiency
4. Children with Perinatal risk factors like asphyxia, intraventricular hemorrhage, hypoglycemia, seizures etc

6.Sampling Procedure: Period Study -Convenient Sampling

1. Sample size - 180 children

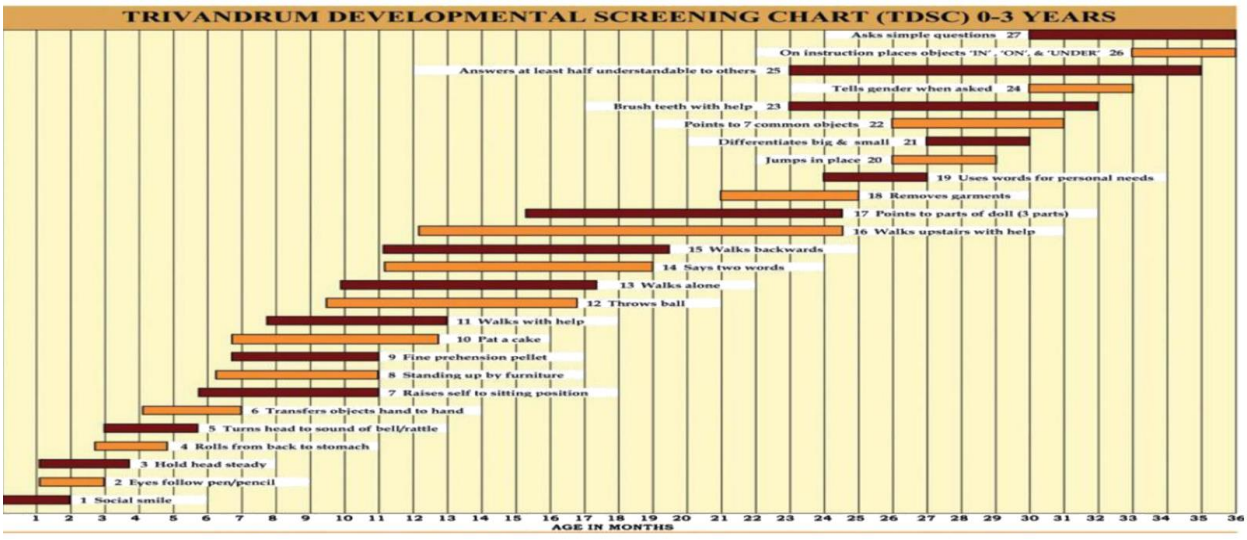
7.Recrruitment, Data Collection & Tools:

1. Data Collection:

This study was conducted after ethical committee approval . Those children fulfilling the inclusion criteria were enrolled and their parents were explained about the study . Out- patients were included in the study. Anthropometry of these children were measured . Anthropometric parameters such as weight for age , Length for age (till 2 years of age), Height for age ,mid-arm circumference , head circumference were measured and plotted in WHO standard growth chart (Z score Chart) . Weight of the child was measured using calibrated weighing scale ,length of the child was measured with an Infantometer& height using a Stadiometer. Mid-Arm Circumference was measured at the mid-point between Olecranon Process & Acromion Process. Head Circumference was measured from occipital prominence to glabella in an overlapping technique using a non-stretchable inch tape. If the weight for Height falls between -2 to +2 Z score then it is considered normal ,between -2 to -3 is moderate acute malnutrition (MAM) &<-3 Z score is Severe Acute Malnutrition (MAM).If Weight for Height is >+2 Z score it is Overweight &>+3 z score is termed as Obesity. For Children between 60-72 months IAP growth charts were used. BMI was calculated using the formula weight in kilogram divided by height in meter square and they were also plotted in the growth chart in addition to weight for age and height for age. If weight for age less than 3rd centile they were classified as underweight. If height for age less than 3rd centile they were classified as stunting and if BMI less than 3rd centile they were considered as thinness. If BMI more than 23 adult equivalent they were considered Overweight & if BMI more than 27 adult equivalent they were considered as obese .After anthropometrically classifying the child, Trivandrum Developmental Screening Chart was used for identifying developmental delay among children between 6 months to 5 years of age.

2.Study tool:

The Trivandrum Development Screening Chart (TDSC) is a 51-item assessment of cognitive and motor milestones for children 0-6 years old. The actual age of the child was accessed by drawing a vertical line through the chart through their age. If the child can complete any items that are to the left of the line, then there is no delay for that item. If an item lies to the left of the line and the child cannot complete the item, then there is an item delay .



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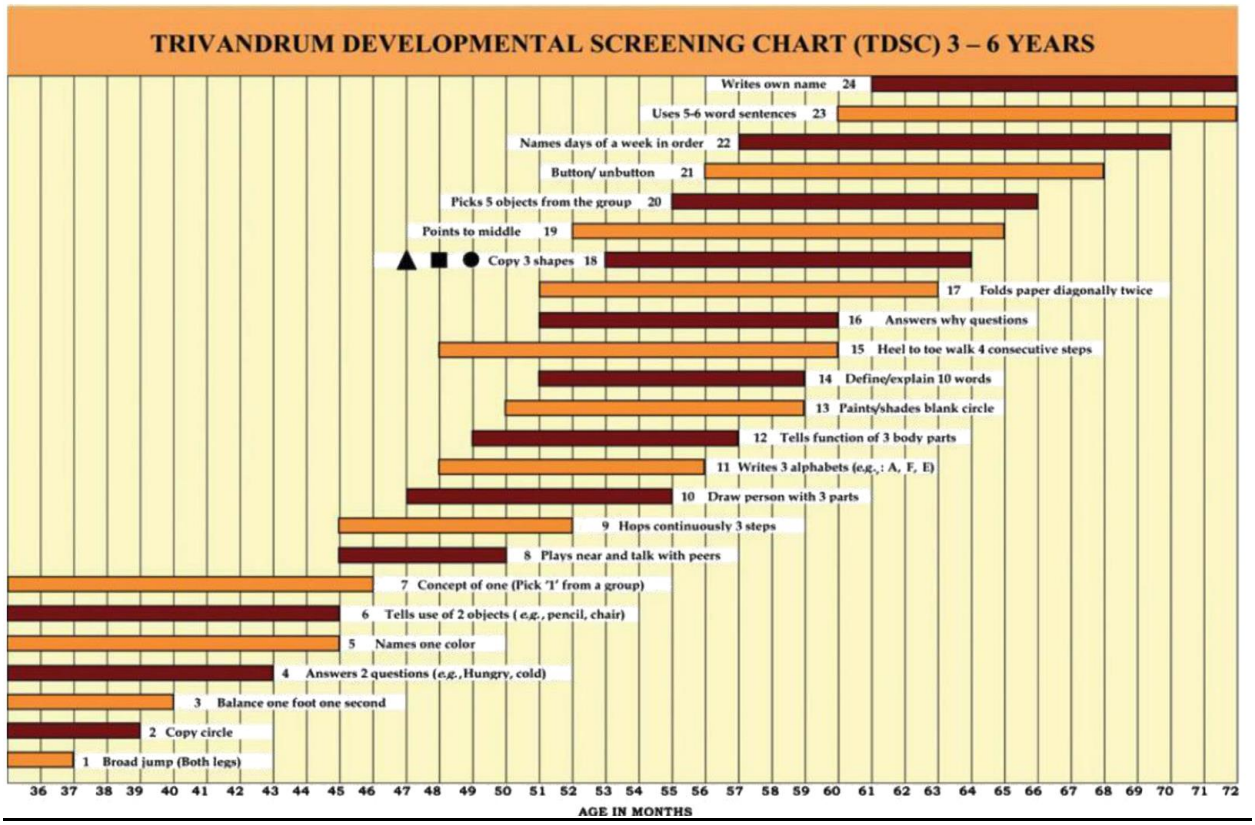

Results:

Our study is on toddlers(12-35 months) and preschool children(36-60 months) which included 180 participants and according to Trivandrum growth and development charts , they were classified as 0-3 years which included 92 participants and 3-6 years which included 88 participants .

Among 92 participants in the 0-3 years 48 were males and 44 were females in the age group 12 months to 35 months .Out of the 88 participants 50 were males and 38 were females in the age group 36 months to 60 months .

TDSC :0-3 years

	Frequency	Percentage
Male	48	52.2
Female	44	47.8
Total	92	100.0

TDSC : 3-6 years

	Frequency	Percentage
Male	50	56.8
Female	38	43.2
Total	88	100.0

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Figure 1 :

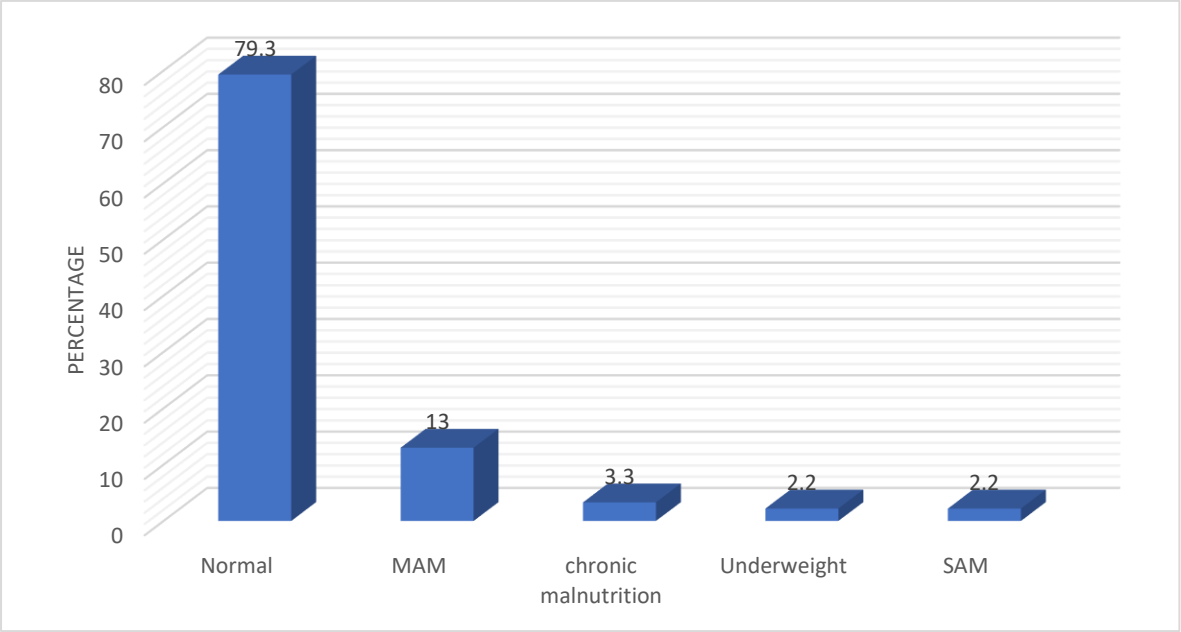

Figure 1 : Out of the 92 participants among 0-3 years age group 79.3% were under normal as per anthropometry , 13% were classified as moderate acute malnutrition , 3.3 % fell under chronic malnutrition ,2.2 participants were underweight and 2.2 % people were observed to have severe acute malnutrition .

Figure 2:

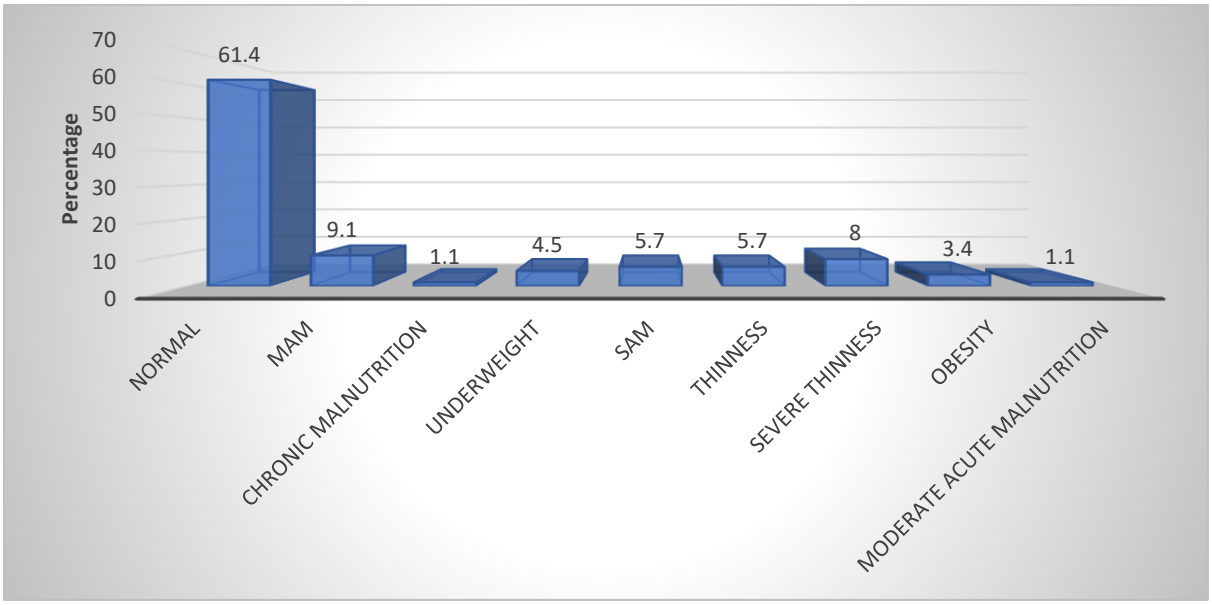

Figure 2 : Between the age group 36 months -72 months out of 88 participants 61.4 % were normal , 10.2 % fell under moderate acute malnutrition , 1.1 % were underweight ,5.7 % were under severe acute malnutrition ,5.7% were under thinness , 8 % were observed to have severe thinness and 3.4 % children were obese .

The questions under TDSC were grouped into gross , fine , language , social and the relation between nutrition and development was assessed .

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In the age group between 0-3 years :

Figure 3 :

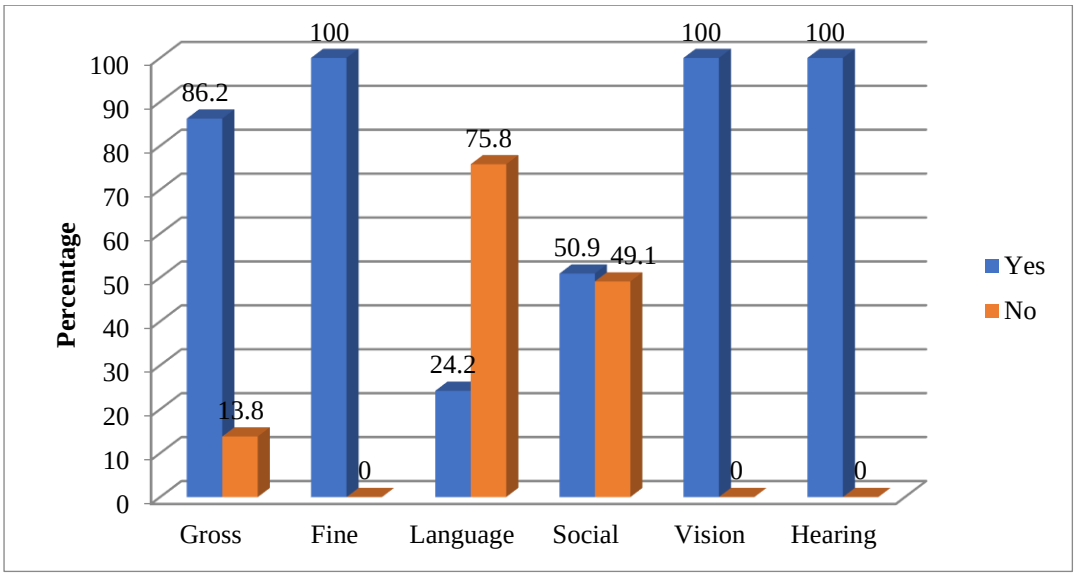

Figure 3 depicts overall score irrespective of nutrition status suggests 86.2% participants were observed to have no delay in gross motor milestones , whereas around 13.8 % were observed to have delay as they were not able to perform the gross motor task in TDSC , almost all children (100%) did not have fine motor delay .The language milestone showed almost 75.8% delay and only 25.8 % had achieved language milestones appropriate for age. Amongthe social milestones , 50.9 % had no delay in social milestones and and 49.1% had a delay as they couldn't perform the task as per TDSC . Vision and hearing were attained by all the children (100%) .

Figure 4 :

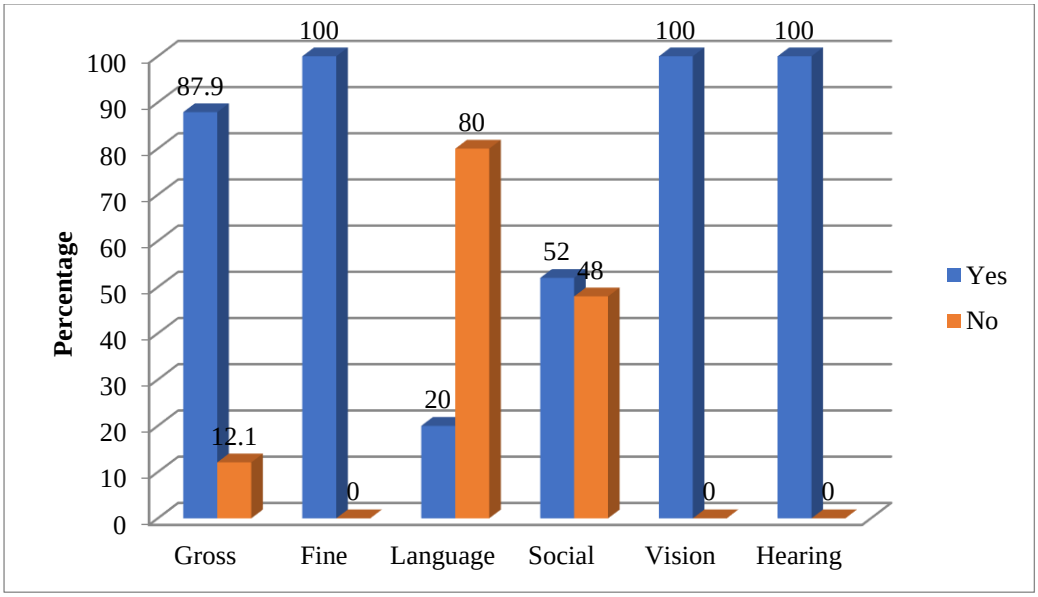

Figure 4: In children with normal anthropometry interpretation 87.9 % of children achieved gross motor milestones , 80% of children had delay in language milestones whereas there was an equivocal response in social milestones (52% of Children achieved social milestones appropriate for age whereas 48% children showed delay in social milestones)

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Figure 5 :

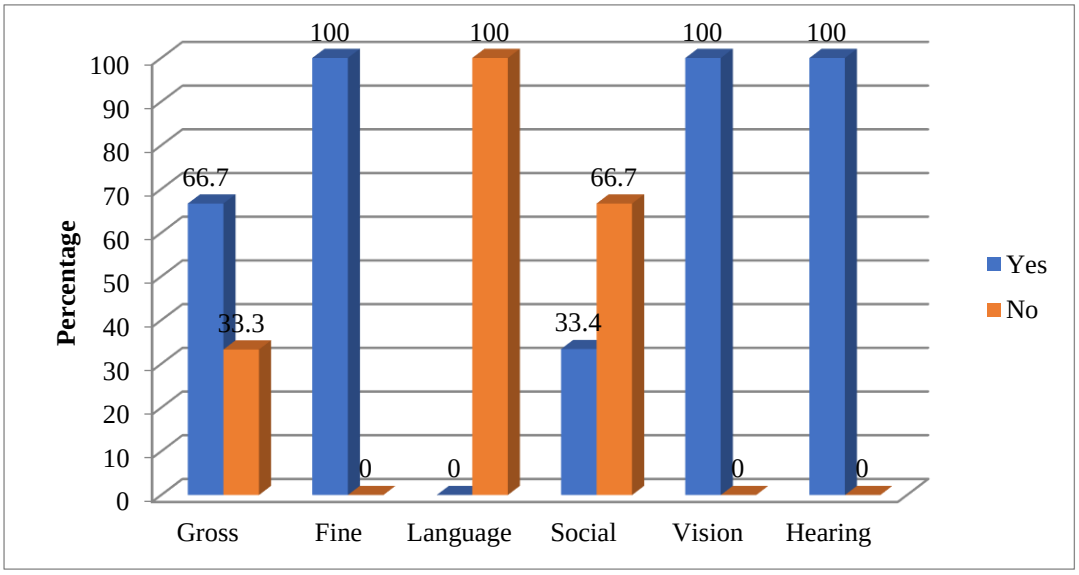

Figure 5 : In children with chronic malnutrition 33.3% children had delay in gross motor milestones , almost all children (100 %) had delay in language milestones and none of the children had delay in fine motor, vision & Hearing milestones

Figure 6 :

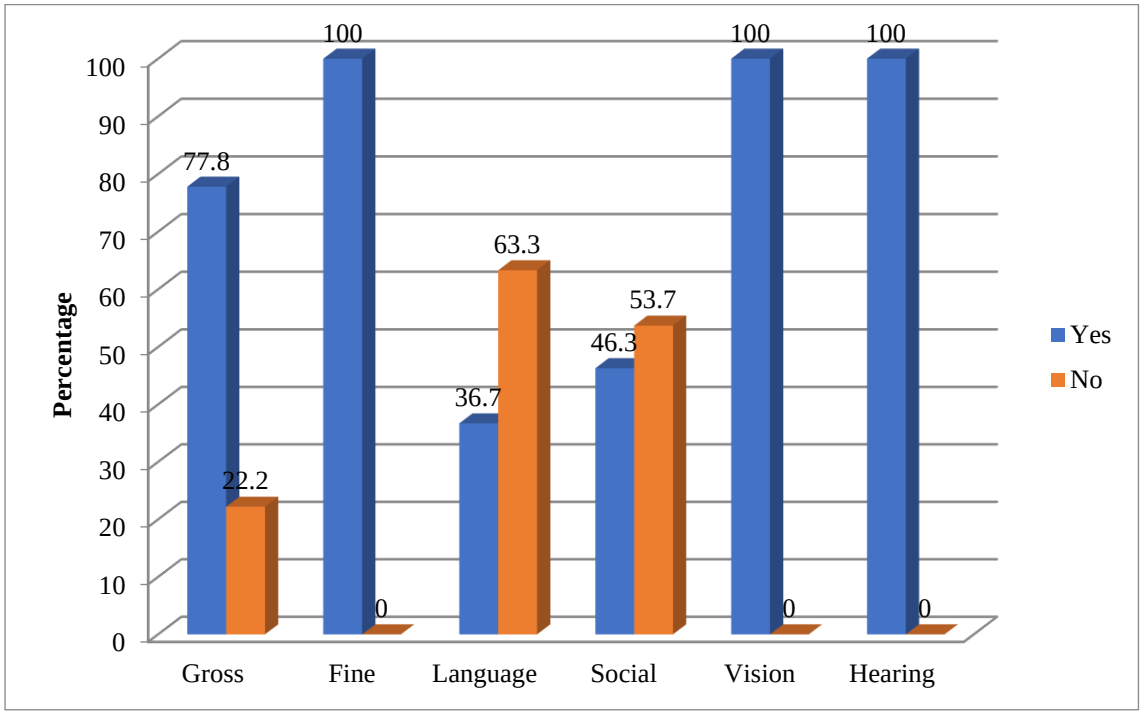

Figure 6 In children with moderate acute malnutrition where 22.2%had gross motor milestone delay , no children had delay in fine motor milestones and around 63.3% and 53.7 % had delay in language and social milestones respectively .

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Figure 7

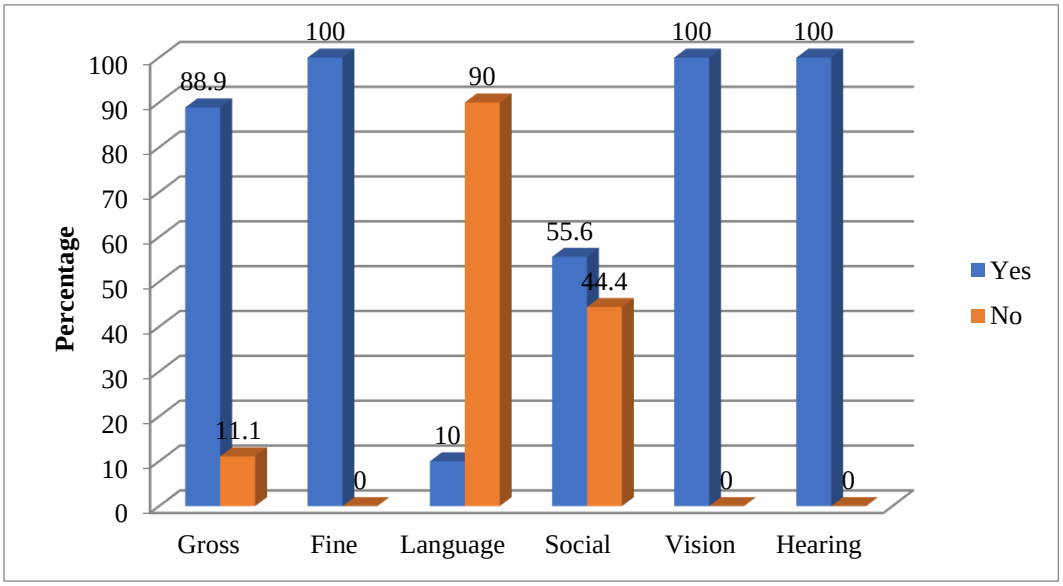

Figure 7: In severe acute malnutrition 11.1 % children had gross milestone delay , no children had delay in fine motor milestones and around 90% and 44% % children had delay in language and social milestones respectively .

Figure 8 :

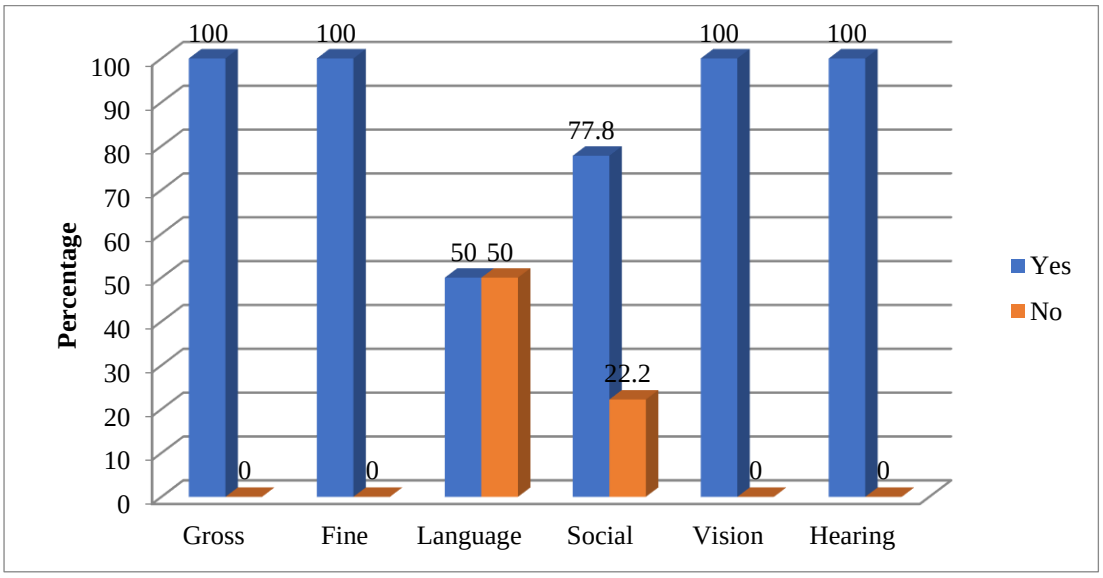

Figure 8 : In underweight children ,around 50 % and 22.2 % children had delay in language and social milestones respectively and none of these children had gross /fine motor delay .

In the age group between 3- 6 years as per TDSC comparison of nutrition and development is as follows .

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Figure 9 :

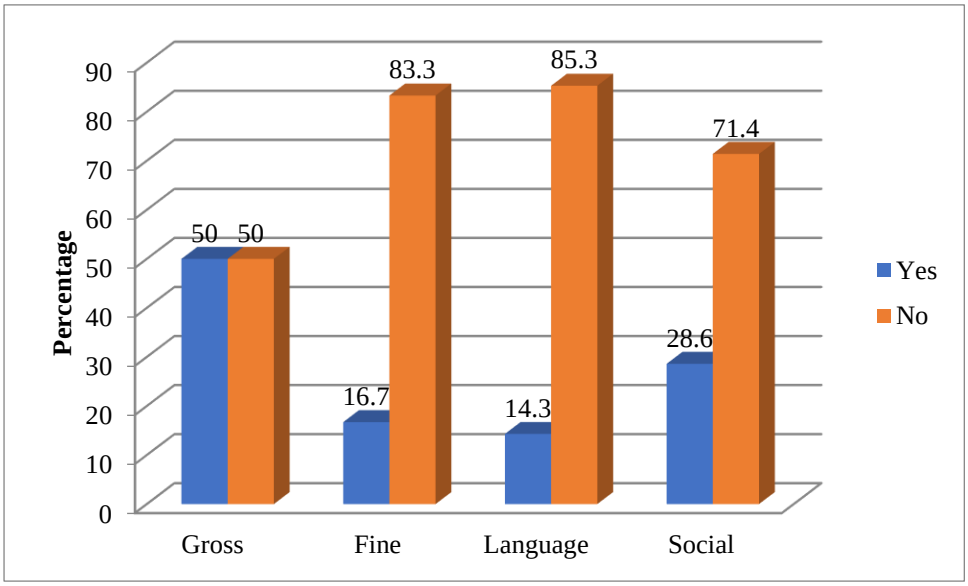

Figure 9 In children with chronic malnutrition , 50 % ,83.3%,85.3% & 71.4% children had delay in gross , fine , language and social milestones respectively .

Figure 10 :

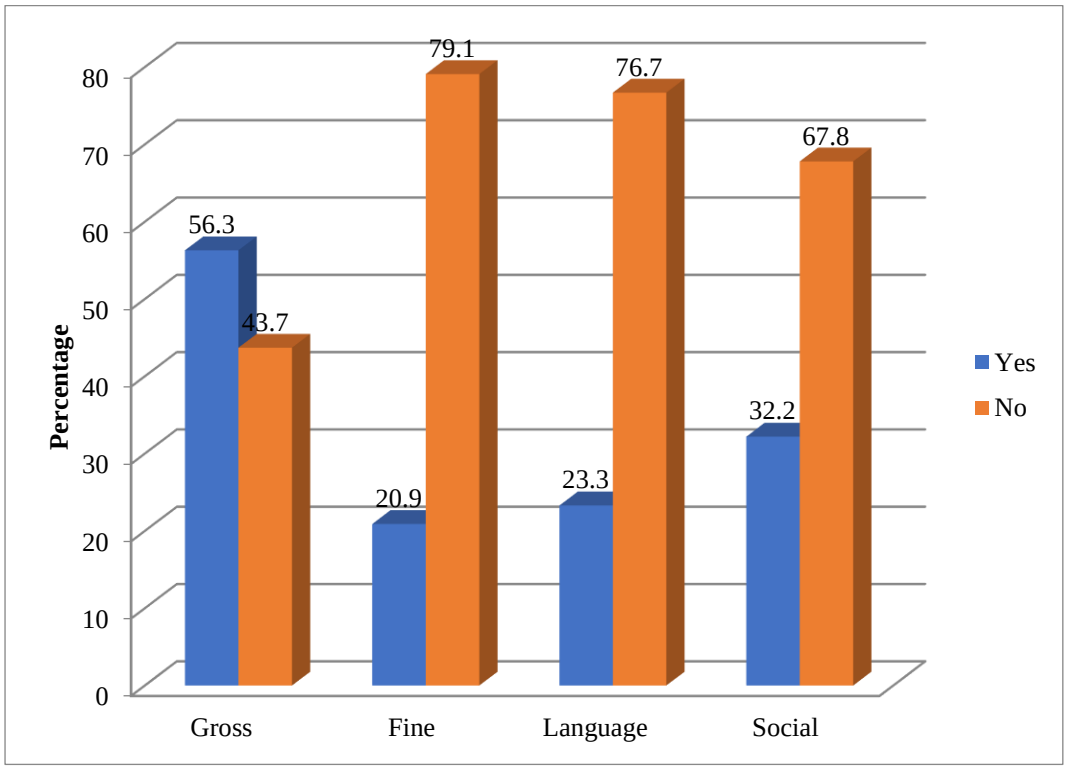

Figure 10 In children with moderate acute malnutrition 43.7 % ,79.1%,76.7 % & 67.8 % children had delay in gross , fine , language and social milestones respectively .

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Figure 11 :

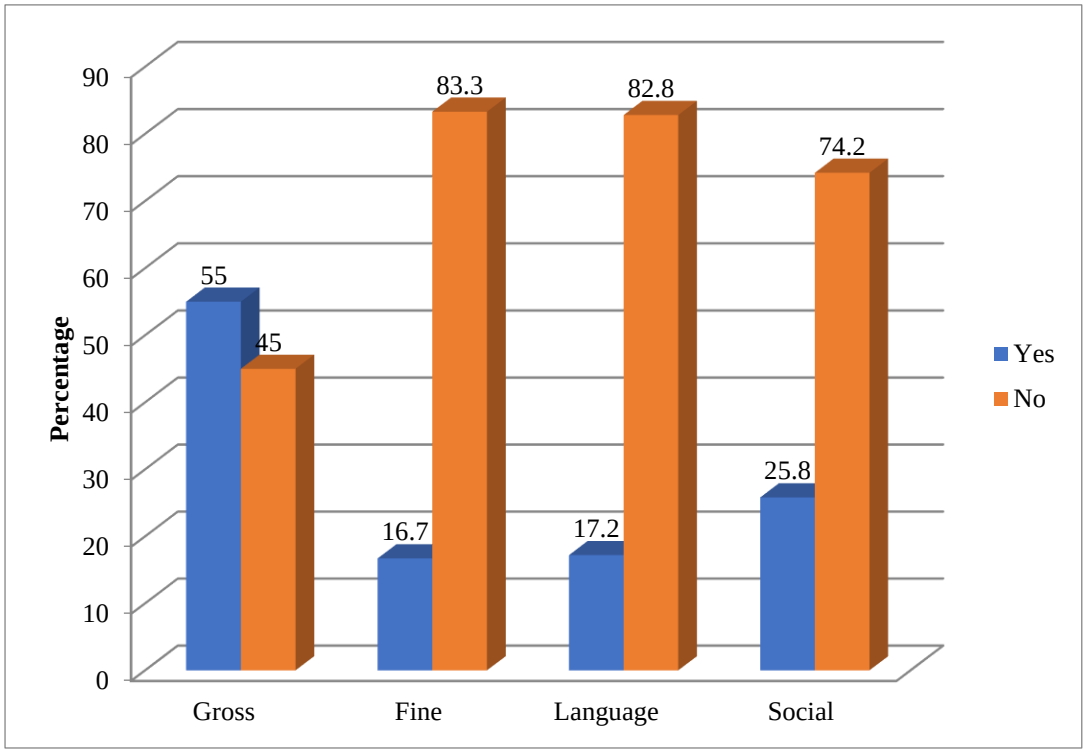

Figure 11 In children with Severe acute malnutrition (SAM) , 45 % ,83.3%,82.8 % & 74.2 % children had delay in gross , fine , language and social milestones respectively .

Figure 12 :

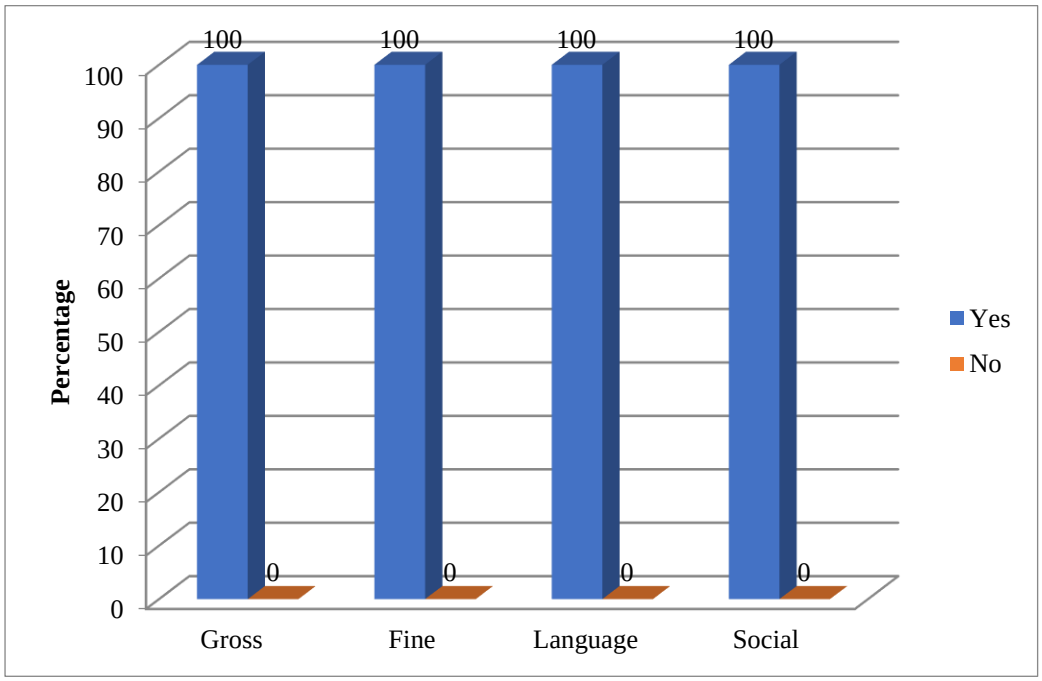

Figure 12 In Children with thinness, severe thinness ,obesity and underweight showed no delay in all 4 milestones .

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Figure 13 :

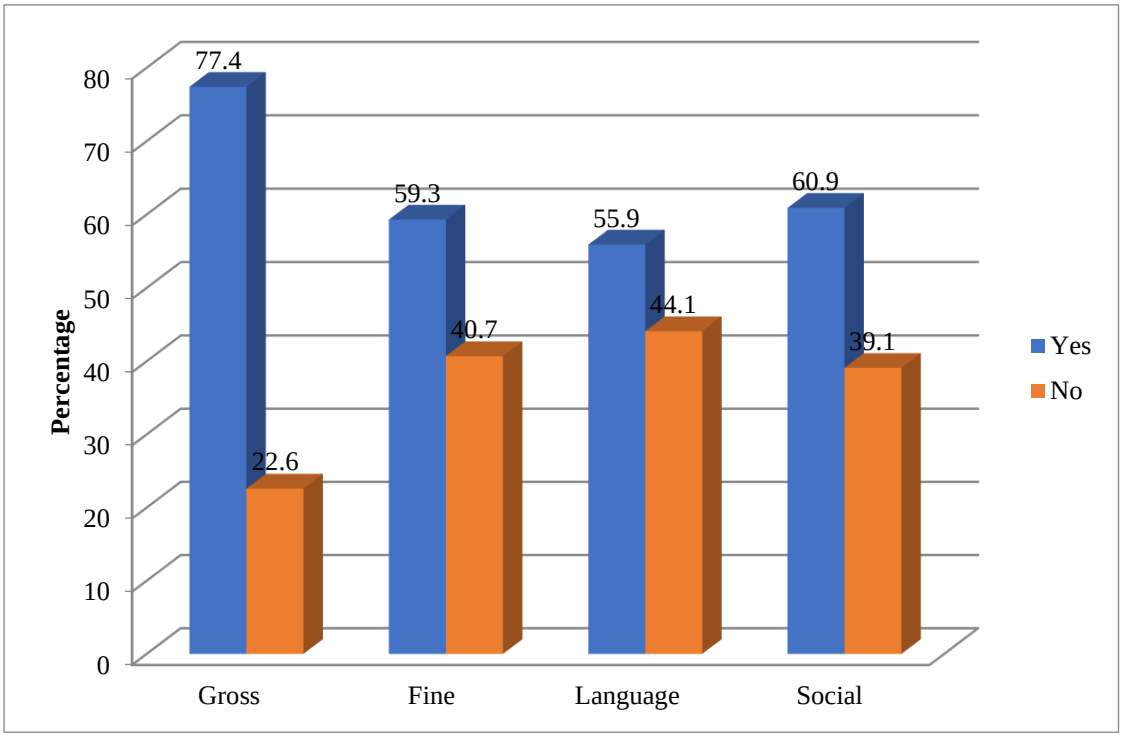

Figure 13 In normal children, 22.6 % ,40.7 %,44.1 % & 39.1 % children had delay in gross , fine , language and social milestones respectively .

Figure 14 :

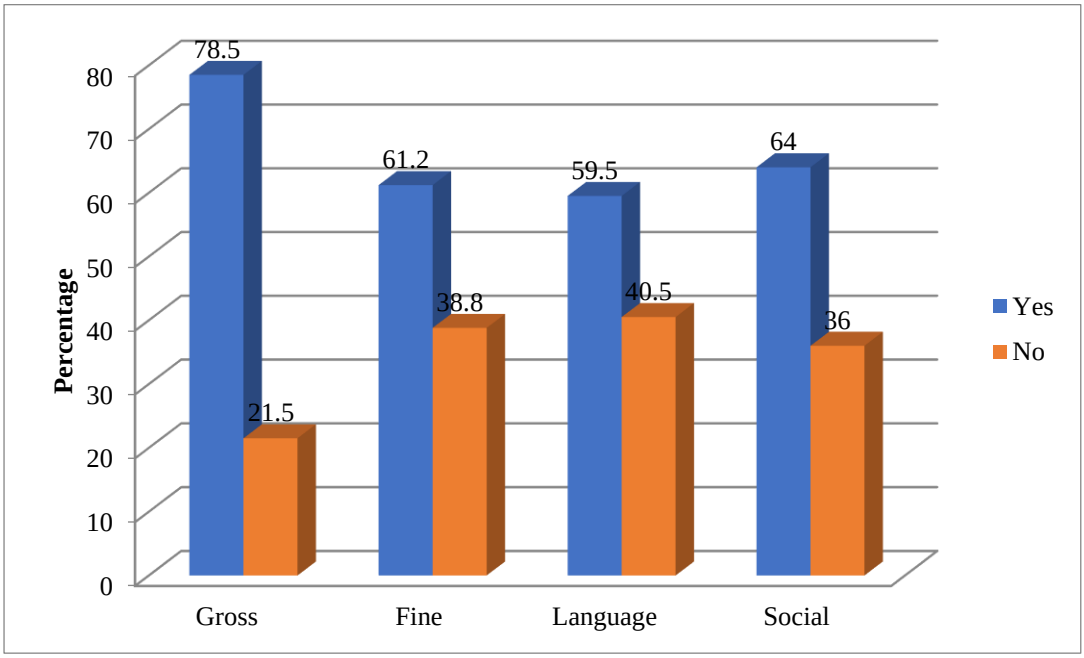

Figure 14: The overall development in the age group between 36 – 72 months showed 21.5 % ,38.8%,40.5 % & 36 % children had delay in gross , fine , language and social milestones respectively .

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Figure 15 :

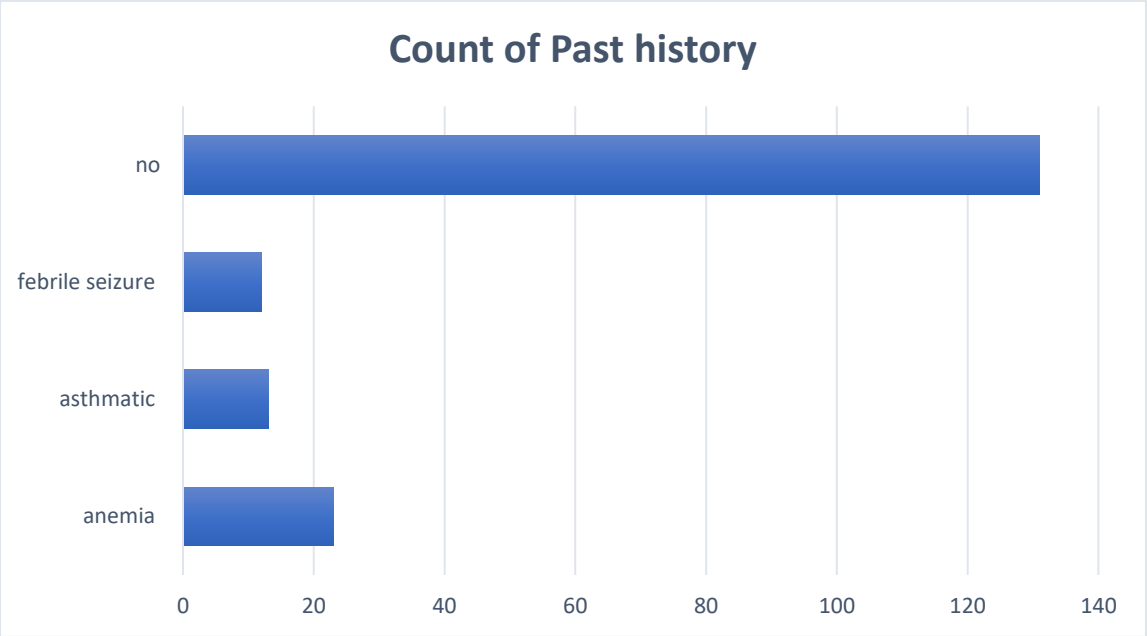

Figure 15:Out of 180 participants 23 children had anaemia , 13 children were asthmatic and around 131 children had no significant past history .

Figure 16 :

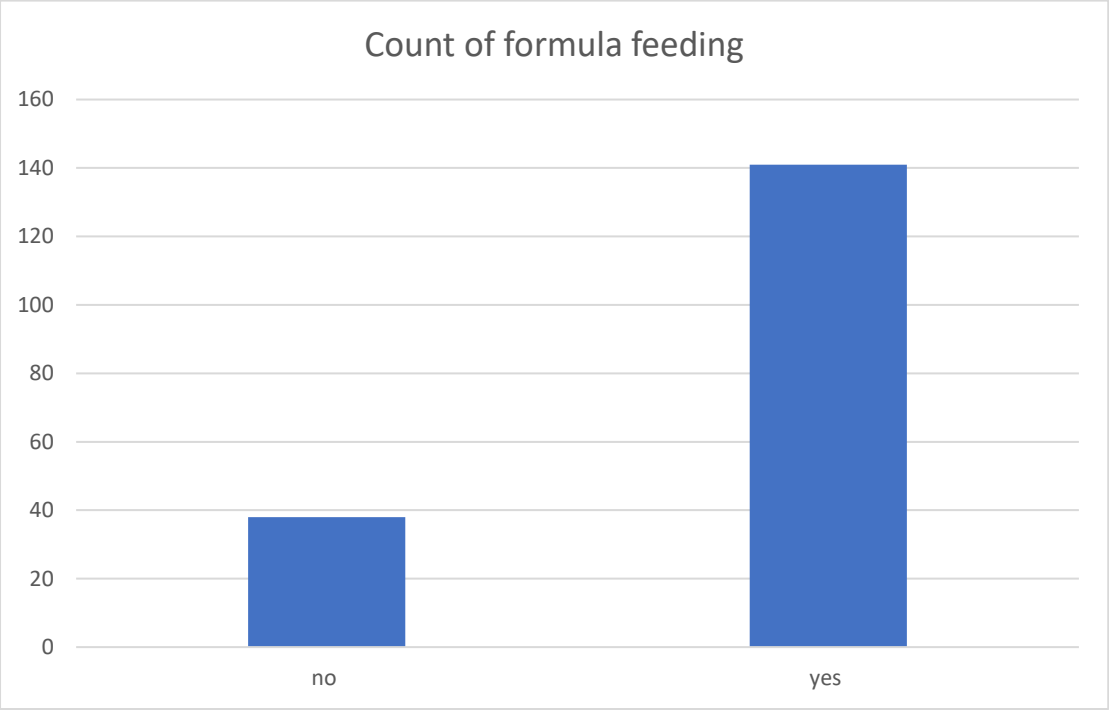

Figure 16: In the present study all 180 participant's received breast milk but were not exclusive breast fed as around 141 babies were formula fed

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Figure 17 :

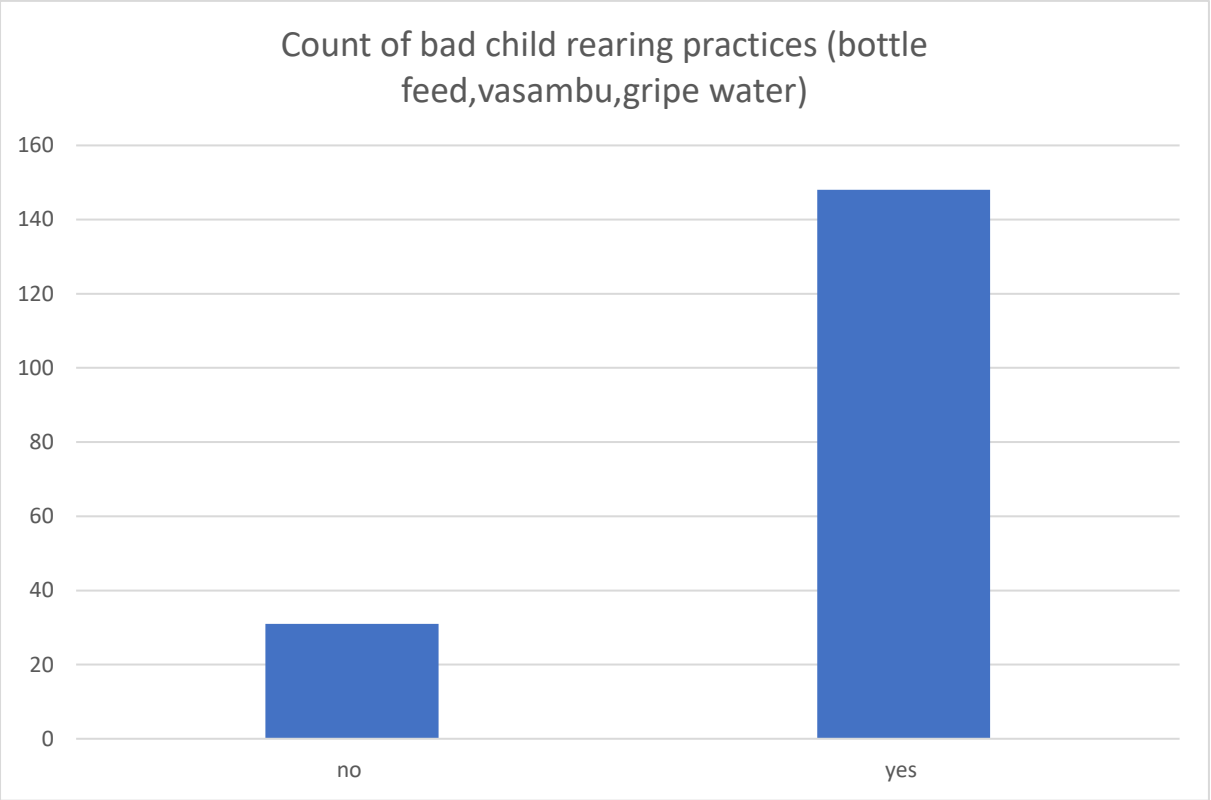

Figure 17 : Out of 180 Participants almost 148 participants had bad child rearing practices

DISCUSSION:

SOCIO-ECONOMIC STATUS:

Our study included 180 participants out of which 92 were between 12 -35 months and 88 were between 36 - 72 months .Almost all the participants belonged to the lower socioeconomic status who were not affordable for good quality food thus affecting the activities of the daily living in the children

A study by Joan Lubx, MD; Andy Belder PhD' et al provided novel data to inform the mechanisms by which poverty negatively impacts childhood brain development. To investigate whether the income-to-needs ratio experienced in early childhood impacts brain development at school age and to explore the mediators of this effect. Poverty was associated with smaller white and cortical grey matter and hippocampal and amygdala volumes. The effects of poverty on hippocampal volume were mediated by caregiving support/hostility on the left and right, as well as stressful life events on the left.

Amongst the 98 participants overall maximum delay was observed in the language tasks in performing the TDSC (75.8%)(16)

Chronic malnutrition :

In our present study it was observed that chronic malnutrition child were found to have 100% language delay and 66.7 % social delay in the age group 12-35 months and 83.3% ,85.3 % and 71.4% in the fine motor , language and social skills respectively between the age group 36-72 months , whereas gross motor activities were relatively performed well ,this may be attributed to the fact that stunting might be one of the major risk factors for delay in development . In the present study it also shows that underweight does not influence much / any delay in the development

In the study by D Casale 1, C Desmond et al 2014 found a strong association between stunting in early childhood and educational attainment and/or cognitive performance among children of school-going age. They analysed the association between stunting (height-for-age z-score <-

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2) at age 2 years and children's scores on the Vineland Social Maturity Scale (VSMS) at age 4 years, a measure of social competence or 'daily living skills', and the Revised-Denver Pre screening Developmental Questionnaire (R-DPDQ) at age 5 years, a test which places greater emphasis on cognitive functioning.(4)

In the study by Ann C Miller , Andreas Garchitorena et al 2020 it proved that although chronic malnutrition was not independently associated with delay risk in this population with high rates of stunting , a high proportion of Malagasy children in this cohort are at risk for developmental delay ,specifically in the areas of early literacy and numeracy .(5)

Severe acute Malnutrition :

In the present study the children with severe acute malnutrition , developmental delay was observed in language and social milestones in children between 12-35 months .Whereas in children between 36-72 months had fine motor , language & social milestones delay

In the study by Liesbeth Bruckers2, et al study revealsthat the developmental performance of SAM children is seriously affected during the acute stage. This effect is multidimensional and age-dependent. Hence rehabilitation of SAM children should be multi-dimensional, age-specific and focus on strengthening of motor skills during early age. Interventions at health institution have to transcend the mere goal of achieving growth and survival as prime measures of successful health outcomes and include development as an important component as well. Younger SAM children are more affected than older ones on all the domains of development. The delay in Fine Motor, Gross Motor, Language generally decreases with an increase in age. Social-emotional behaviour problems seemed to be most pronounced in the very young and older age ranges. SAM has a differential age effect on the different dimensions of development in children under 6 years of age.(23)

STUNTING:

In our present study it was observed that stunted children as a part of chronic malnutrition were found to have 100% language delay and 66.7 % social delay in the age group 12-35 months and 83.3% ,85.3 % and 71.4% in the fine motor , language and social skills respectively between the age group 36-72 months , whereas gross motor activities were relatively performed well ,this may be attributed to the fact that stunting might be one of the major risk factors for delay in development

Whereas in a study by **Wilda Welis1,*, Darni2, Khairuddin2, et al 2022** revealed the causes of stunting and physical activity at an early age had an impact of stunting on motor development(12)

In the present study , the children falling under underweight , thinness , severe thinness ,obesity did not have any major effect on the developmental outcome stating that decrease in weight does not have major effect on the developmental outcome .

Developmental Delay:

Our study suggests that the overall incidence of gross motor developmental delay in children between 0-3 years was about 13.8 % as they were not able to perform the gross motor task in TDSC , almost no children had fine motor delay .The language milestone showed almost 75.8% delay and only 25.8 % had achieved language milestones appropriate for age. Among the social milestones , 50.9 % had no delay in social milestones and and 49.1% had a delay as they couldn’t perform the task as per TDSC . Vision and hearing were attained by all the children (100%) .

Similarly a study by MKC Nair,Babu George et al 2009, suggested that out of 12520 children upto 5 years of age , there were a total of 311 children with developmental delay, deviation, deformity or disability giving a prevalence of 2.5 % (95 % CI, 2.22 to 2.77). The prevalence of developmental disabilities up to 2 years was 2.31 (95 % CI, 1.91 to .71) and from 2 to 5 years 2.62 % (95 % CI, 2.25 to 2.99). The prevalence obtained in the study had important policy implications for identifying childhood disabilities in the community.(3)

Language Delay & Socio economic status:

Our study was done in an urban setting which included a population of lower socio-economic status and it was found that about 75% children were found to have language delay.

Similarly a study done by Matthew M, Cappiello BA et al 2009 suggested that the risk for language delay in bilingual indigenous households may be related to conditions associated with poverty. Therefore, indigenous children who were living in impoverished

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circumstances may have higher rates of language delay compared with children in more advantaged settings. It isimportant to systematically screen for language delay in low-income indigenous settings.(25)

Malnutrition and Developmental delay:

Our study suggests that In children with chronic malnutrition 33.3% children had delay in gross motor milestones , almost all children (100 %) had delay in language milestones & In children with moderate acute malnutrition where 22.2% had gross motor milestone delay, 63.3% and 53.7 % had delay in language and social milestones.

A study by Vazir, AN Naidu et al suggested that Malnourished children attained developmental milestones at a later age. Developmental delay among the malnourished was especially observed in areas like vision and fine motor, language and comprehension and personal social. The delay was to the extent of 7-11 months in these areas in different age groups. (2)

Language delay :

Our study suggested that there was an incidence of 75% language delay in children between 0-3 years of age

Similarly a study done by Glascoe FP, Byrne et al suggested that developmental problems including language impairments, learning disabilities, mild mental retardation, and/or functional developmental delay were found in 17% of the children. But the screening tool used in this study was Denver II developmental screening tool.(25)

CONCLUSION:

- In children between 0-3years of age among 92 participants about 21% of children had malnutrition either in the form of Moderate Acute Malnutrition(MAM),Severe Acute Malnutrition(SAM),Chronic Malnutrition or Underweight.
- In children between 36months-72 months 37% children were either underweight, malnourished or thin & 3% children were found to be obese.
- In children between 0-3 years it was observed that there was no significant difference in attaining the milestones or having developmental delay in both normal children as well as in malnourished child.
- In children between 36months-72months it was observed that in children with chronic malnutrition / Moderate Acute Malnutrition there was a delay in gross milestones followed by social milestones.
- In children with thinness, severe thinness, obesity & Underweight there was no developmental delay in all 4 domains.
- On Contrary children with normal anthropometry were found to have delay in fine ,language & social milestones

LIMITATIONS:

- This was a single centered study
- Sample size was small

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