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# Evaluation of the Functional Motor Abilities in Preterm Children Using GMFM 66

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## Abstract

**Background:** For children with increased risk of neurodevelopmental deficiencies, such as preterm and low birth weight infants, it is desirable to make early predictions with regard to outcome. This is important for the family, for the researchers designing appropriate follow-up and intervention programmes.

**Aims:** To evaluate the functional motor abilities in preterm children using GMFM 66.

**Settings and Design:** Observational Study Design, conducted at physiotherapy OPD, Pad Dr. Vitthalrao Vikhe Patil Hospital, Ahmednagar.

**Methods and Material:** An observational study was carried out for 1 year in hundred children who were born at 24 to 31 weeks gestation with age group from 1 to 6 years with mean age of 3 years. The sample selection was based on convenient sampling method. The children were evaluated according to their gestational age. This study was carried out in Dept. Of Physiotherapy, Vikhe Patil Memorial Hospital, Ahmednagar. The Children of 1- 6 years of either sex were included in the study whereas the patients who had No parental consent, Uncooperative Children and children admitted for unstable medical conditions were excluded from the study. The study was approved by institutional ethical committee of PDVVPF's COPT Ahmednagar. The guardians signed an informed consent form allowing the children's participation. The GMFM 66 had administered on hundred preterm children and collected data were compared with standard values of GMFM 66.

The GMFM was developed in the 1980s, the GMFM is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with cerebral palsy. It is widely used for both clinical and research purposes. The GMFM test activities in five dimensions, lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping. It has good reliability and validity in assessing gross motor functions of children less than three years old. (ICC=O.99).

**Statistical analysis used:** Unpaired 't' test was used for between group comparison.

**Results:** The result of present study indicated functional variability of premature children i.e. significant variability in functionality within the different dimension of GMFM lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping.

**Conclusions:** The present study concluded that there is functional variability of premature children i.e. significant variability in functionality within the different dimension of GMFM lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping.

**Keywords:** GMFM -66, preterm children, EP, CP

## Introduction

For children with increased risk of neuro developmental deficiencies, such as preterm and low birth weight infants. Motor impairments have long been recognized in preterm children without cerebral palsy [1,2]. Much of the motor impairment relates to poor performance in relation to the low cognitive scores generally found in preterm children, but it has been suggested that motor and other neuropsychological problems may also occur independently of cognitive impairment in very low birth weight children [3]. The contribution of primary motor problems to the totality of impairment in Extremely Preterm (EP) infants without cerebral palsy is unclear. Executive functions are broadly synonymous with function of the prefrontal cortex of the brain and supporting loops but may be variously interpreted as functions, needed to achieve goal directed behaviour. Hence, it is desirable to make early predictions with regard to outcome. This is important for the family, for the researchers designing appropriate follow-up and intervention programmes.

Gross motor behaviour in children with CP has been conceptualized as having two main features: function and performance. We use the term "gross motor function" to describe the accomplishment of motor activities, or how much the child does, for example, standing independently for 10 seconds. In this context, "function" does not necessarily refer to activities that are purposeful to the child or performed in everyday settings. Instead, functional activities are defined as traditional gross motor milestone behaviour's that can be tested in a standardized manner. The term "gross motor performance" describes the quality of motor activities, or how well the child does the activity, for example, the degree of stability when standing [4]. Hence, the purpose of this study is to measure functional motor abilities in preterm children.

There are various assessment measures available to assess the functional motor abilities of children viz., Miller Function and Participation Scales (M-FUN) [5] and Peabody Developmental Motor Test. But As the M--FUN scale can be used to assess individual children from 2 years 6 months to 7 years 11months of age and Peabody Developmental Motor Test can be used to assess children from Birth to five years [5]. We used the Gross Motor Function Measure 66 to measure the functional motor abilities in preterm children.

The measure used in childhood disability is the criterion-referenced Gross Motor Function Measure (GMFM)[4]. The GMFM was designed and validated for children with Cerebral Palsy (CP) by using principles of classical test theory and is used widely as a clinical and research outcome measure. Although the GMFM has been useful to document gross motor function in a systematic way, a limitation of the measure is that the scoring (and thus interpretation) is based on ordinal-level data.

The Gross Motor Function Measure (GMFM) has demonstrated high levels of validity, reliability, and responsiveness in the assessment of motor function in children with CP [4]. The GMFM consists of 66 items organized into five dimensions: lying and rolling; sitting; crawling and kneeling; standing; and walking, running, and jumping. Although these items do not assess children within different environmental contexts, nor do they represent activities chosen by children themselves, they were chosen by therapists as important for developmental progress and amenable to change.

Thus the GMFM-66 was chosen to evaluate the functional motor abilities in preterm children.

## Subjects and Methods

An observational study was carried out for 1 year in hundred children who were born at 24 to 31 weeks gestation with age group from 1 to 6 years with mean age of 3 years. The sample selection was based on convenient sampling method. The children were evaluated according to their gestational age. This study was carried out in Dept. of Physiotherapy, Vikhe Patil Memorial Hospital, Ahmednagar. The Children of 1- 6 years of either sex were included in the study whereas the patients who had No parental consent, Uncooperative Children and children admitted for unstable medical conditions were excluded from the study. The study was approved by institutional ethical committee of PDVVPF's COPT Ahmednagar. The guardians signed an informed consent form allowing the children's participation. The GMFM 66 had administered on hundred preterm children and collected data were compared with standard values of GMFM 66.

The GMFM was developed in the 1980s, the GMFM is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with cerebral palsy [5]. It is widely used for both clinical and research purposes. The GMFM test activities in five dimensions, lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping. It has good reliability and validity in assessing gross motor functions of children less than three years old (ICC=O.99) [5].

## Results

A total of 100 subjects were included in the study. The baseline characteristics demographics (age, gender) are shown in **Table 1 and Graph 1**. The **Table 2** and **Graph 2** shows the mean score of GMFM according to Age and Sex which demonstrates that the

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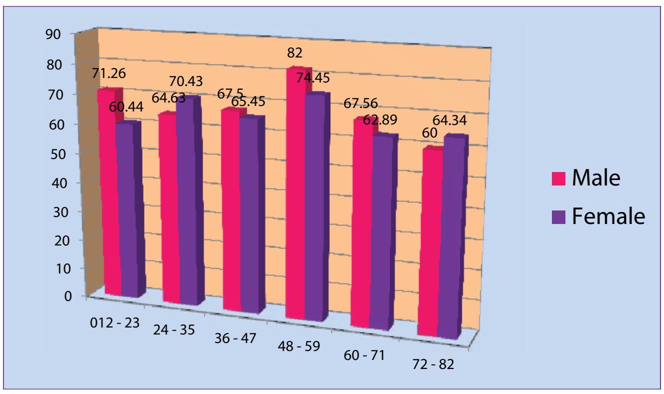
gross motor functional abilities were reduced in female preterm children when compared with male preterm children. **Table 3** shows the comparison of mean score of GMFM between Normal children and preterm children according to Age demonstrates that the gross motor functional abilities were significantly affected in preterm children when compared with normal children of same age. **Table 4** shows mean score Of GMFM at different distributions demonstrates abnormal score of GMFM (5 distinct components) viz., lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping and compared or normal score (normal children) [6].

**Graph 2** shows mean score of GMFM at $D_1$ at (lying and rolling) demonstrates that the gross motor functional abilities in lying and rolling were significantly reduced in preterm children (abnormal score ) when compared with normal children (compared score) with respective age. **Graph 3** shows mean score of GMFM at $D_2$ at (sitting) demonstrates that the gross motor functional abilities in sitting were significantly reduced in preterm children (abnormal score) when compared with normal children (compared score) with respective age. **Graph 4** shows mean score of GMFM at $D_3$ at (Crawling and Kneeling)demonstrates that the gross motor functional abilities in crawling and kneeling were significantly reduced in preterm children (abnormal score) when compared with normal children (compared score) with respective age. **Graph 5** shows mean score of GMFM at $D_4$ at (Standing) demonstrates that the gross motor functional abilities in standing were significantly reduced in preterm children (abnormal score) when compared with normal children (compared score) with respective age. **Graph 6** shows mean score of GMFM at $D_5$ at (walking, running and jumping) demonstrates that the gross motor functional abilities in walking, running and jumping were significantly reduced in preterm children (abnormal score) when compared with normal children (compared score) with respective age.

**Table 1** Age and sex distribution.

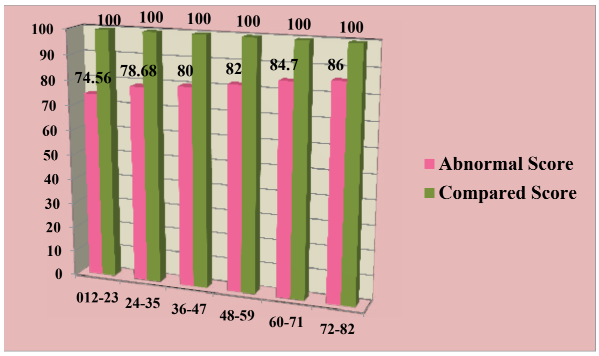
| Age (months) | Male | Female | Total |
|---|---|---|---|
| 12-23 | 6 | 6 | 12 |
| 24-35 | 6 | 9 | 13 |
| 36-47 | 5 | 9 | 16 |
| 48-59 | 8 | 11 | 19 |
| 60-71 | 9 | 11 | 20 |
| 72-82 | 8 | 11 | 20 |




**Graph 1** shows mean score of GMFM according to Age & Sex.

**Table 2.** Mean score of GMFM according to age and sex.

| | Mean Score (%) | | |
|---|---|---|---|
| Age (months) | Male | Female | Total |
| 12-23 | 71.26 % | 60.44 % | 65.85 % |
| 24-35 | 64.63 % | 70.43 % | 67.53 % |
| 36-47 | 67.50 % | 65.45 % | 79.42 % |
| 48-59 | 82 % | 74.45 % | 78.24 % |
| 60-71 | 67.56 % | 62.89 % | 65.24 % |
| 72-82 | 60% | 64.34 % | 62.17 % |




**Graph 2** shows mean score of GMFM at $D_1$ at (lying & rolling).

compared with normal children (compared score) with respective age.

**Table 5** shows comparison of mean score of GMFM between Normal children and preterm children according to distribution of 5 distinct component of GMFM viz. lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping demonstrates that the gross motor function abilities were significantly reduced in preterm children (abnormal score) when compared with normal children (compared score) with respective age with the p value = 0.05.

## Discussion

The result of present study indicated functional variability of premature children i.e significant variability in functionality within the different dimension of GMFM lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping.

This study confirms a significant difference between functional motor abilities of preterm children compared with normal full term children. The results show that a child with a developmental disorder like CP affects various functional motor abilities on GMFM. Physical or mental disabilities at birth or during growth and development significantly affects the functional motor abilities.

The study conducted by Neil Marlow, Enid M. Hennessy, et

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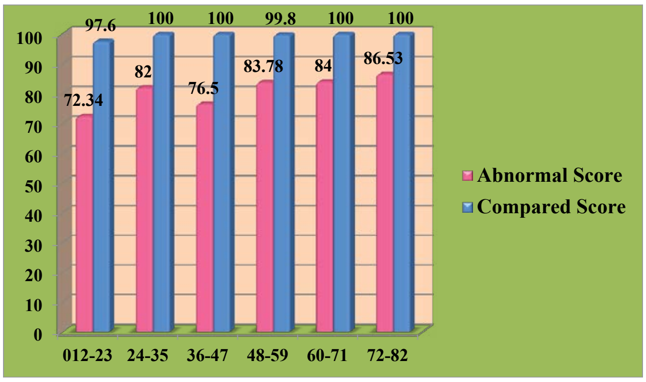
**Table 3** Comparison of mean score of GMFM between normal children andpreterm children according to age.

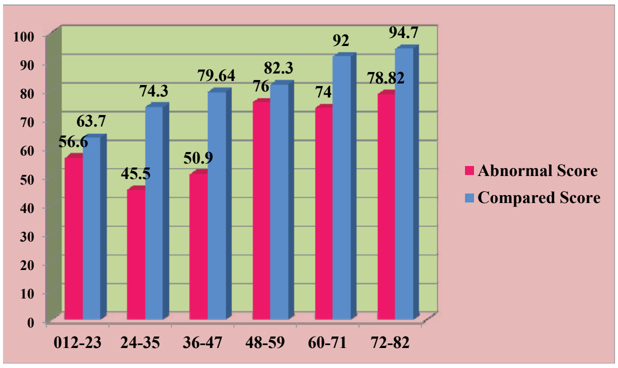
| | 12-23 | 24-35 | 36-47 | 48-59 | 60-71 | 72-82 |
|---|---|---|---|---|---|---|
| **p value** | 0.0015 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| **t value** | 3.554 | 8.824 | 4.425 | 5.250 | 18.534 | 24.646 |
| | Highly Significant | Extremely Significant | Extremely Significant | Extremely Significant | Extremely Significant | Extremely Significant |

**Table 4** Mean score of GMFM at different distributions.

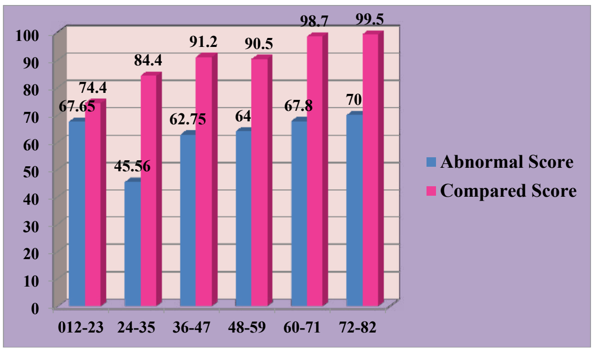
| Age (months) | Lying and rolling | | Sitting | | Crawling and Kneeling | | Standing | | Walking, running, jumping | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Abnormal Score | Compared Score | Abnormal Score | Compared Score | Abnormal Score | Compared Score | Abnormal Score | Compared Score | Abnormal Score | Compared Score |
| **Dec-23** | 74.56 | 100 | 72.34 | 97.6 | 67.65 | 74.4 | 56.6 | 63.7 | 34.54 | 42.7 |
| **24-35** | 78.68 | 100 | 82 | 100 | 45.56 | 84.4 | 45.5 | 74.3 | 33.33 | 57 |
| **36-47** | 80 | 100 | 76.5 | 100 | 62.75 | 91.2 | 50.9 | 79.64 | 43.2 | 60.5 |
| **48-59** | 82 | 100 | 83.78 | 99.8 | 64 | 90.5 | 76 | 82.3 | 42 | 71.3 |
| **60-71** | 84.7 | 100 | 84 | 100 | 67.8 | 98.7 | 74 | 92 | 49 | 90 |
| **72-82** | 86 | 100 | 86.53 | 100 | 70 | 99.5 | 78.82 | 94.7 | 56.67 | 91.8 |




**Graph 3** Shows mean score of GMFM at $D_2$ at (Sitting).




**Graph 5** Shows mean score of GMFM at $D_4$ at (Standing).

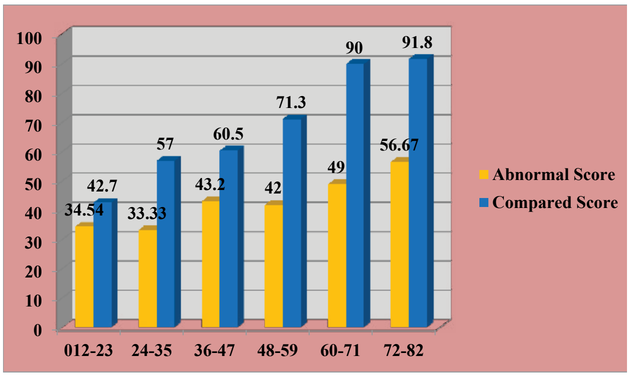



**Graph 4** Shows mean score of GMFM at $D_3$ at (Crawling & Kneeling).

**Table 5** Comparison of mean score of GMFM between normal children and preterm children according to distribution.

| Distributions | p value | t value |
|---|---|---|
| Lying and rolling | < 0.0001 | 9.052 |
| Sitting | 0.05 | 7.097 |
| Crawling and Kneeling | 0.0017 | 4.924 |
| Standing | 0.0579 | 1.7625 |
| Walking, running, jumping | 0.015 | 2.63 |

al on Motor and Executive Function at 6 Years of Age After Extremely Preterm Birth [3]. In this study when EP children (at<or=25 completed weeks')without cerebral palsy compared with classmates, demonstrated high prevalence of impairment in visuospatial, perceptuomotor, attention-executive, and gross motor function at early school age. These deficits are greater than would be expected given the cognitive deficit we reported in this population. In each area, approximately half the deficit in motor skills or executive function was not accounted for by impairment in the cognitive score. It is likely, therefore, that motor and executive-function difficulties make an important additional contribution to the child's performance reported by teachers in the class setting. The presence of motor difficulties in very low birth weight and preterm infants is well described. But even after excluding those with a diagnosis of cerebral palsy or those in a special school who will have poorer motor function than those




**Graph 6** Shows mean score of GMFM at $D_5$ at (Walking, Running, Jumping).

analyzed, the deficit covers all areas tested and usually amounts to 1 SD of standardized tests. It is thus likely to be clinically important. Given the broad areas of difference between the EP children and their classmates over the range of functions examined it would seem that the summative epithet "poor motor skills" is likely to have a range of underlying etiologic pathways. Vohr and Wright, et al. conducted the study on spectrum of gross motor function in extremely low birth weight children with Cerebral Palsy at 18 months of age [7]. The purpose of this study was to evaluate the relationship between Cerebral Palsy (CP) diagnoses as measured by the topographic distribution of the tone abnormality with level of function on the Gross Motor Function Classification System (GMFCS) and developmental performance on the Bayley Scales of Infant Development II (BSID-II) concluded that given the range of gross motor skill outcomes for specific types of CP, the GMFCS is a better indicator of gross motor functional impairment than the traditional categorization of CP that specifies the number of limbs with neurologic impairment. The neurodevelopmental assessment of young children is optimized by combining a standard neurologic examination with measures of gross and fine motor function (GMFCS and Bayley Psychomotor Developmental Index).

Lee, et al. conducted one study on Gross motor skills of premature, very low-birth weight Chinese children [1]. They investigated whether premature, Very Low-Birth Weight (VLBW) Asian children without major handicap had poor motor skills compared with their normal birth weight counterparts. We compared a cohort of 42 preterm babies with birth weights <1500 g who participated in a developmental stimulation programme with 69 children of normal birth weight matched for age, gender and paternal education. VLBW children participated in the programme for 3 years and were followed to the age of 5-7 years. The VLBW cohort had significantly lower scores in B- and C-rated skills of the Peabody Developmental Motor Scales. Their total score was also significantly lower. This is in agreement with studies in other populations that found that VLBW children had lower motor scores and that early interventions failed to ameliorate this motor disadvantage.

The research review conducted by Allen, Marilee on Neurodevelopmental outcomes of preterm infants [8]. as Preterm birth is emerging as a major public health problem in the USA in that many develop motor, cognitive and sensory impairments. So to improve in preterm birth and survival rates translate to increasing numbers of preterm survivors is the purpose of the review. The review discussed the recently reported prevalence of neurodevelopmental disabilities in preterm survivors, in addition to studies of factors associated with neurodevelopmental outcome. The summary of review is that according to 2007 report from the Institute of Medicine emphasizes preterm birth as an increasingly common complex condition with multiple risk factors resulting from multiple gene–environmental interactions, leading to birth before 37 weeks gestation, neonatal complications and a disproportionately high contribution to neurodevelopmental disability rates. The increased risk of cerebral palsy with decreasing gestational age categories is well documented, but recent studies highlight the range and severity of cognitive, sensory, language, visual-perceptual, attention and learning deficits in very preterm children. Combined with increasingly sophisticated neuroimaging studies to identify perinatal risk factors, neurodevelopmental follow-up of neonatal intensive care unit trials offers the potential to really improve our understanding of how the preterm brain develops, is injured and recovers from injuries. Knowledge of what influences neurodevelopmental outcomes is key to developing better treatment strategies.

Future Implication: The results of the present study is useful for future to implement the newer treatment techniques in preterm children. Thereby we can prevent or reduce the neurodevelopmental complications and thereby make the child functional independent.

## Conclusions

The present study concluded that there is functional variability of premature children i.e significant variability in functionality within the different dimension of GMFM lying and rolling, sitting, crawling and kneeling, standing and walking, running and jumping.

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