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RESEARCH ARTICLE

A STUDY TO DETERMINE THE CORRELATION BETWEEN GROSS MOTOR FUNCTION CLASSSIFICTION SYSTEM[GMFCS] & SPINAL ALIGNMENT AND RANGE OF MOTION MEASURE IN CHILDREN WITH SPASTIC CEREBRAL PALSY

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Key words:-
GMFCS, SAROMM, Spastic Diplegia

Abstract

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Background: Children with diagnosis of CP are at the risk of developing joint and muscle contractures. GMFCS was developed based on self initiated movement with particular emphasis on sitting and walking. SAROMM provides a method to determine the spinal deviations and range of motion limitations. There is greater emphasis on trunk and lower extremities than the upper extremities. Correlating these two scales will give us an idea of gross motor limitations and range of motion limitations in children with spastic cerebral palsy.
Objectives: To find out the correlation between GMFCS and SAROMM in children with spastic cerebral palsy.
Methodology: This study includes 60 spastic diplegic children between the ages of 5- 12 years. The children were screened for the inclusion and exclusion criteria. An informed consent was taken from the child's Parents and Guardian's prior to the study.
Results: The correlation between GMFCS and SAROMM was calculated using Pearson's Correlation Coefficient. There was positive correlation with r=0.538 and p=0.000.
Interpretation & Conclusion: From this study we can conclude that there is positive correlation between GMFCS and SAROMM in children with spastic diplegia.

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Introduction:-

Martin Bax et al (2005) proposed the definition for cerebral palsy (CP) as a well recognized neurodevelopmental condition beginning in early childhood and persisting through the lifespan. It describes a group of disorders of development of movement and posture causing activity limitation that are attributed to non-progressive disturbances that occurred in developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, cognition, communication, perception and/or behavior and/or by seizure disorder.[1]

The pathophysiological events may occur during the prenatal, intrapartum, perinatal or early postnatal period.[2]

It occurs in about 2 to 2.5 per 1000 live births and is the most prevalent childhood neuromuscular condition seen by pediatric rehabilitation practitioners including physiotherapists.[3]

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According to Eva Beckung and Gudrun Hagberg (2002) cerebral palsy is a group of severe disabiling conditions in childhood that places heavy demands on health, education and social services as well as on the families and children themselves. Neuroimapirments of agonist-antagonist muscles, muscle weakness and limited range of motion affect gross and fine motor function.[4]

Children with a diagnosis of CP are at risk of the development of muscle and joint contractures and spinal malalignment especially if they have spasticity.[5]

Attempts have been made to classify the severity of CP using systems based on quality of the tone and/or movement disorder (eg. Spastic, hypotonic, athetoid), the pattern of involvement (eg. Diplegia, hemiplegia) and/or trunk control, independent sitting, ambulation, etc. To address these challenges GMFCS (Palisano et al 1997) was developed to provide an objective classification of the patterns of motor disability in children with CP.[6]

C. Karr et al (2006) states that for a child with bilateral spastic CP, the impairment may be muscle weakness in the lower limbs; the activity limitation, being unable to walk further than 100 metres outdoors; and the participation restriction being unable to complete a sponsored walk with friends.[7]

Palisano et al (1997) believed that classification of children with CP on the basis of abilities and limitations in gross motor function should enhance communication among professionals and families with respect to:-

1. Determining a child’s needs and making management decisions.
2. The creation of databases describing the development of children with CP.
3. Comparing and generalizing the results of program evaluation a research into the outcome of treatment.[8]

GMFCS is based on self initiated movement with particular emphasis on sitting and walking.[6]

GMFCS is a five level scale that rates a child’s gross motor function with an emphasis on movement initiation sitting control and walking. Level I represent the highest gross motor function whereas level V represents the lowest.[9]

Christopher Morris and Doreen Bartlett (2004) suggested that GMFCS has been used in both observational and experimental research to describe study sample and to explore the role of severity of functional limitations as an effect modifier.[10]

GMFCS can help enormously when setting functional goals collaborations with families.[10]

Ostensjo (2004) found that amount of leg spasticity and deviations in range of motion is related to type of CP and GMFCS level.[11]

Inter rater reliability of GMFCS was 0.55 for children less than 2 years of age and 0.75 for children 2-12 years of age in children with spastic cerebral palsy.[8]

Greater limitations are typically observed among children with more severe levels of involvement as they age.[5]

SAROMM provides a method that is reliable for estimating overall deviation in spinal alignment and limitations of ROM. It contains 4 items for spinal alignment and 11 items for ROM and muscle extensibility that are tested bilaterally for a total of 26 items. The total SAROMM score possible is 0-104.[5]

There is greater emphasis on trunk and lower extremities than the upper extremities. By design, SAROMM includes those items that are most likely to influence the aquisition or maintenance of basic motor abilities, such as rolling, crawling, sitting, pulling-to-stand, transferring and walking.[5]

The total scores for both interrater and test-retest is more than 0.80 in children with CP.[5]

GMFCS has been rapidly accepted in clinical practice and research.[12] The GMFCS is a reliable and valid scale to determine the gross motor function in children with CP.[8]

Although the opinion of experts was that the GMFCS classification system can be used to classify accurately the gross motor function of children between 1 and 2 years of age there has been some comments made by experts that this will be difficult.[8]

SAROMM is a reliable method for estimating overall deviations in Spinal alignment and limitations of ROM in children with CP. Also it can be used to describe the pattern of restrictions across different regions of the body.[5]

This study intends to find out the correlation between the levels obtained from GMFCS with the scores obtained from SAROMM in spastic cerebral palsy children

By correlating these two scales will help the clinicians to identify spinal alignment and limitations of ROM with reference to GMFCS.

Utilizing this; the clinician can establish an effective treatment protocol by describing the current functional level of child and documenting it overtime.

Need Of The Study

1. To know whether the different levels of GMFCS are correlating to the scores of SAROMM.
2. This will provide correlation between spinal alignment, limitations of range of motion and gross motor functional limitations when used by rehabilitation practitioners.
3. This will direct the practitioners for treatment goals.

Aims And Objectives:-

Aims:

To find out the correlation between GMFCS and SAROMM in children with spastic cerebral palsy.

Objectives:-

To correlate GMFCS and SAROMM in children with spastic cerebral palsy.

Hypothesis

Experimental hypothesis:

There will be a correlation between GMFCS and SAROMM.

Null Hypothesis:

There will not be any correlation between GMFCS and SAROMM.

Review Of Literature:-

Gunel M K et al (2008) investigated the relationship among functional classification system and functional status in 185 children with spastic cerebral palsy. Among them 65 were diparetic, 60 were quadriparetic and 60 were hemiparetic ranging from 4-15 years of age. They concluded that there is a good correlation between the GMFCS and MACS [Manual Ability Classification System] ($r=0.735$, $p<0.01$) in all children. Also correlation was found between GMFCS and WeeFIM($p<0.01$).[12]

M. Wichers et al (2009) did a study to determine the prevalence of motor impairments and activity limitations and their inter-relationships in Dutch children with spastic CP. They have taken 119 children with age group 6-19 years and examined anthropometry, muscle tone, abnormal posture, joint range of motion, major orthopaedic impairments and gross motor functioning and manual ability. They found that children with spastic CP had a lower body height and weight compared with typically developing peers. Forty percent had no range of motion deficits. Hip dislocations were rarely encountered. Motor impairments were associated with gross motor functioning and manual ability levels. Close to sixty-five percent walked independently. Children with diplegia and tetraplegia differed in activity limitations. They stated the prevalence of motor impairements an activity limitation as in relation to major CP characteristics.

D. Oeffinger et al (2008) did a study on 381 ambulatory CP children with age group of 4-18 years based on GMFCS levels I-III. They have used GMFCS as one outcome measure and examined changes in score overtime. It was responsive when change in function occurred large enough to cause a change in GMFCS level. A systematic method of defining MCID was established using the variability of change scores in groups. These threshold values can be used to assess change in population overtime.

D. Oeffinger et al (2007) assessed the relationships between GMFCS level and scores on outcome tools used in pediatric orthopaedics. A total of 562 participants with CP with age group 4-18 years (339 males, 223 females; 400 with diplegia, 162 with hemiplegia; GMFCS levels I-III) were taken. They used Functional Assessment Questionnaire, Gross Motor Function Measure-Dimensions D and E, Pediatric Quality of Life Inventory, the Pediatric Outcomes Data Collection Instrument, Peidatric Functional Independence Measure, temporal-spatial gait parameters and O_2 cost as an outcome measure. They concluded a direct relationship between GMFCS level and outcome measures of ICF activities and participation and Body functions and structures. This study also provides comparison data for clinicians to use when assessing individual children with CP in GMFCS levels I, II and III. The study data illustrates that children with varying levels of severity function differently yet have a similar quality of life.

Katharina Delhueen Carnahan et al (2007) aimed to study the association between gross motor function and manual ability in a total population of children with cerebral Palsy. 365 children born between 1992 to 2001 were included in study. Cerebral Palsy diagnosis and subtypes were determined by the neuropediatircian at or after the age of four. They stressed the importance of joining together information about the cerebral palsy subtypes and functional evaluations. The GMFCS and MACS seem to work well in this context and are both very useful in describing motor function characteristics in populations of children with cerebral palsy.[10]

Elroy Sullivan et al (2007) studied relationships among fuctional outcomes measures used for assessing children with ambulatory CP. They included 562 children (339 males, 223 females) with age group of 4-18 years. They were classified according to GMFCS levels I-III. They concluded that PODCI, FAQ and GMFM dimension E were appropriate with ambulatory CP. The WeeFIM self care and mobility sub-scales also related well to other measures of physical functioning. When available temporal-spatial parameters and O_2 cost are important indicators of physical function. In addition to the measures examined in this study, new tools are constantly being developed toward improving our understanding and documentation of functional outcomes in ambulatory children with CP.

Hui-Ting Goh et al(2006) did a study to determine the relationship among knee muscle spasticity, isometric knee muscle strength, knee muscle balance, gross motor function and walking efficiency in children with spastic CP. They included 27 children with spastic dipelgia. They used GMFCS and GMFM as an outcome measure. They found hamstring strength and quadriceps spasticity explain much of variance in gross motor function and comfortable walking efficiency.

Sigrid ostensjo et al (2005) describes the use of assistive devices and other environmental modifications and their impact on everyday activities and care in young children with CP. 95 children; 55 boys, 40 girls; mean age 58 months; and their parents were studied. The study documented a cleat relation between use of environmental modifications and GMFCS levels. They also suggest the use of GMFCS for planning of assistive technology services.

Doreen Barlett et al (2005) described the development and preliminary psychometric testing of Spinal Alignment Range of Motion Measurement. 25 children and adolescents with cerebral palsy with mean age of 9 years and 8 months were included. Among them 22 were spastic and 1 each with hypotonic, athetoid and mixed cerebral palsy. They concluded that the SAROMM has sufficient content and construct validity, and interrater and test-retest reliability, for the use in clinical and research settings for the purpose of discrimination by rehabilitation physiotherapist.[2]

Sigrid Ostensjo et al (2004). They assessed the distribution of spasticity, range of motion deficits and selective motor control problems in children with cerebral palsy.95 children with mean age of 58 months were included. Among them 19 were hemiplegic, 40 were spastic diplegic, 4 were ataxic, 16 were spastic quadriplegic, 9 were dystonic and 7 had mixed. They highlighted the importance of measuring spasticity and ROM in several muscles and across joints. [5]

Amy Winter Bodkin et al (2003) studied the inter-rater reliability and construct validity of the Gross Motor Function Classification System. 23 children with cerebral palsy and 27 with Down syndrome were included in the study. Average age was 13.9 for cerebral palsy and 15.3 for Down syndrome. They concluded that GMFCS has good reliability and validity supporting its use in clinical practice and research.[6]

Eva Beckung et al (2002) studied the associations between neuroimpairments, activity limitations and participation restrictions in the domains of mobility, education and social relations as proposed in the International Classification of Functioning Disability and health. 176 children with cerebral palsy aged 5-8 years were included in study. They concluded that GMFCS and BFMF had a strong correlation of 0.74.[3]

Gayatri kembhavi et al (2002) studied the use of Berg Balance Scale to assess balance abilities of children with CP. 36 ambulatory children with CP and 14 children with no motor impairment with age group 8-12 years were assessed on BBS and GMFM. Participants with CP comprised three groups based on diagnosis (spastic hemiplegia, spastic diplegia who ambulated without aids and spastic diplegia who ambulated with aids). They used GMFCS and GMFM as an outcome measures and they suggested that the BBS can be considered as clinical measure of balance for children with CP and a functional classification system can be used to group children more homogenously than traditional classification by diagnosis.

Ellen Wood et al (2000) studied interrater and intrarater reliability of GMFCS on 85 children from <=2to>=12 years of age by two blinded raters in clinical notes four times throughout the study. They concluded that interrater reliability was high (G=0.93) and Test-retest reliability was high (G=0.79).[9]

Eva Beckung et al (2000) studied the application of International Classification of Impairments, Disabilities and Handicap parallel to GMFCS in 116 children with cerebral palsy. They concluded that there is a significant correlation between high handicap scores as well as high levels on the GMFCS and a presence of learning disability, epilepsy and aetiology of cerebral palsy.[11]

Palisano R et al (1997) developed a five level classification system of GMFCS for a standardized system to classify the gross motor function for children with cerebral palsy. They concluded that interrater reliability was 0.55 for children less than 2 years of age and 0.75 for children 2-12 years of age.[7]

Methodology:-

Sampling:
Purposive Sampling

Study Design:
Descriptive study design

Source Of Data:
Samples are taken from Kashiba paediatric hospital- Baroda, Polio foundation, Sparsh peidatric physiotherapy clinic, Masoom pediatric physoiotherapy clinic, Kalrav special school, Apang manav mandal- Ahmedabad, Gujarat.

Method Of Collection Of Data:
The study consisted of 60 children, both boys and girls, in the age group between 5-12 years who were medically diagnosed as spastic diplegia. Prior to the participation in this study the individuals were explained about the study. An informed consent was taken from the parents of the children. The children were screened for the inclusion and exclusion criteria and those who fulfilled the criteria were considered for the study.

Inclusion Criteria:
1. Children between 5-12 years of age.
2. Children medically diagnosed as spastic diplegia.

Exclusion Criteria:
1. Children severe mental retardation.
2. Children with severe congenital abnormalities.
3. Acute illness (e.g.: fever, cough etc).

4. Any other type of CP.
5. Any respiratory or cardiovascular impairment.

Tools Used For The Study:
1. Pen
2. Paper
3. Firm sitting surface
4. Raised mat
5. SAROMM manual
6. Score sheet
7. GMFCS brochure

The children were administered the following scales:
1. GMFCS
2. SAROMM.

Testing procedure 1: GMFCS
Under this the spastic diplegic children were classified according to their gross motor functions. GMFCS is a five level classification system where Level I represents the highest gross motor function level while Level V represents the lowest. Distinctions are based on functional limitations, the need for hand-held mobility devices (such as walkers, crutches or canes) or wheeled mobility and to a much lesser extent, quality of movement. On following basis children were classified. The focus of the GMFCS is on determining which level best represents the child's or youth's present abilities and limitations in gross motor function.
1. Level I : Walks without limitations.
2. Level II : Walks with limitations.
3. Level III: Walks with handheld mobility.
4. Level IV: Self-Mobility with limitations; May used powered mobility.
5. Level V : Transported in a manual wheel chair.

Palisano et al (2007) gave an expanded and revised form of GMFCS which was given according to different age groups. Children included in this study were classified according to that are as follows:
Between 4^{th} and 6^{th} birthday:
LEVEL I: Children get into and out of, and sit in, a chair without the need for hand support. Children move from the floor and from chair sitting to standing without the need for objects for support. Children walk indoors and outdoors, and climb stairs. Emerging ability to run and jump.

LEVEL II: Children sit in a chair with both hands free to manipulate objects. Children move from the floor to standing and from chair sitting to standing but often require a stable surface to push or pull up on with their arms. Children walk without the need for a handheld mobility device indoors and for short distances on level surfaces outdoors. Children climb stairs holding onto a railing but are unable to run or jump.

LEVEL III: Children sit on a regular chair but may require pelvic or trunk support to maximize hand function. Children move in and out of chair sitting using a stable surface to push on or pull up with their arms. Children walk with a hand-held mobility device on level surfaces and climb stairs with assistance from an adult. Children frequently are transported when traveling for long distances or outdoors on uneven terrain.

LEVEL IV: Children sit on a chair but need adaptive seating for trunk control and to maximize hand function. Children move in and out of chair sitting with assistance from an adult or a stable surface to push or pull up on with their arms. Children may at best walk short distances with a walker and adult supervision but have difficulty turning and maintaining balance on uneven surfaces. Children are transported in the community. Children may achieve self-mobility using a powered wheelchair.

LEVEL V: Physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Functional limitations in sitting and standing are not fully compensated for through the use of adaptive equipment and assistive technology. At Level V, children have no means of independent movement and are transported. Some children achieve self-mobility using a powered wheelchair with extensive adaptations

Between 6th and 12th birthday:

Level I: Children walk at home, school, outdoors, and in the community. Children are able to walk up and down curbs without physical assistance and stairs without the use of a railing. Children perform gross motor skills such as running and jumping but speed, balance, and coordination are limited. Children may participate in physical activities and sports depending on personal choices and environmental factors.

Level II: Children walk in most settings. Children may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas, confined spaces or when carrying objects. Children walk up and down stairs holding onto a railing or with physical assistance if there is no railing. Outdoors and in the community, children may walk with physical assistance, a hand-held mobility device, or use wheeled mobility when traveling long distances. Children have at best only minimal ability to perform gross motor skills such as running and jumping. Limitations in performance of gross motor skills may necessitate adaptations to enable participation in physical activities and sports.

Level III: Children walk using a hand-held mobility device in most indoor settings. When seated, children may require a seat belt for pelvic alignment and balance. Sit-to-stand and floor-to-stand transfers require physical assistance of a person or support surface. When traveling long distances, children use some form of wheeled mobility. Children may walk up and down stairs holding onto a railing with supervision or physical assistance. Limitations in walking may necessitate adaptations to enable participation in physical activities and sports including self-propelling a manual wheelchair or powered mobility.

Level IV: Children use methods of mobility that require physical assistance or powered mobility in most settings. Children require adaptive seating for trunk and pelvic control and physical assistance for most transfers. At home, children use floor mobility (roll, creep, or crawl), walk short distances with physical assistance, or use powered mobility. When positioned, children may use a body support walker at home or school. At school, outdoors, and in the community, children are transported in a manual wheelchair or use powered mobility. Limitations in mobility necessitate adaptations to enable participation in physical activities and sports, including physical assistance and/or powered mobility.

Level V: Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control arm and leg movements. Assistive technology is used to improve head alignment, seating, standing, and and/or mobility but limitations are not fully compensated by equipment. Transfers require complete physical assistance of an adult. At home, children may move short distances on the floor or may be carried by an adult. Children may achieve self mobility using powered mobility with extensive adaptations for seating and control access. Limitations in mobility necessitate adaptations to enable participation in physical activities and sports including physical assistance and using powered mobility.

Testing procedure 2: SAROMM

Here SAROMM was applied to the children. The subjects were examined in the location of their choice. They were dressed according to the study purpose. A firm sitting surface is required such that the child is able to sit with both hips and knee flexed at 90̊ and a raised mate so that the child can be examined in supine position.

The spinal deviations were observed in sitting position on the firm surface. If normal spinal alignment is not observed the person was given three opportunities to correct to assume normal positions. If these positions were assumed, a score of 0 is given. If a child was unable to do correct it actively, passive correction was done. The scoring was done as follows:

0 “No alignment limitations with active correction”
1 “Flexible - passive” - limitation is muscular and dynamic; limitation is reducible through passive movement
2 “Fixed” - limitation is structural, static, not reducible and minimal
3 “Fixed” – limitation is structural, static, not reducible and moderate
4 “Fixed” – limitation is structural, static, not reducible and severe

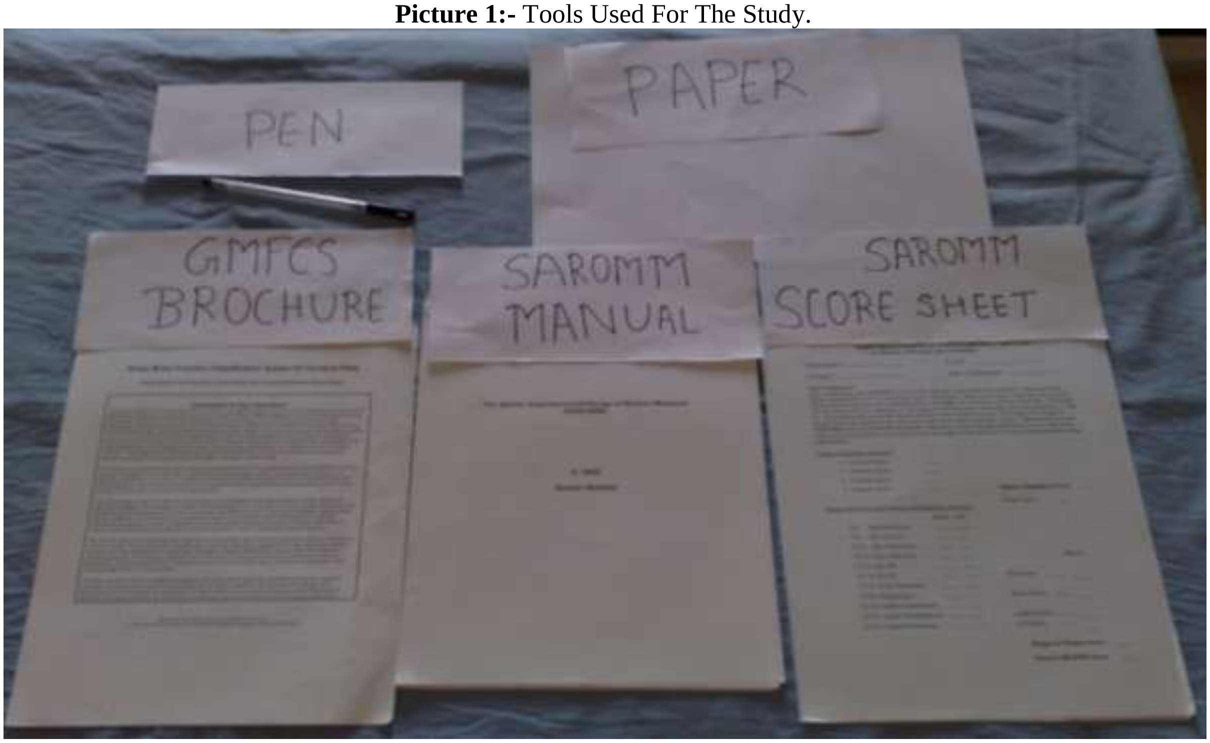
The range of motion of lower limbs was taken in supine position. For this the limbs were moved slowly and firmly so as to minimize the effect of spasticity. The scoring was done as follows:

0 “Normal” – no restriction of ROM on passive testing and no postures typical of some children with cerebral palsy observed
1 “Flexible - passive” - postural limitation is muscular and dynamic; limitation is reducible through passive movement
2 “Fixed” - limitation is structural, static, and irreducible and is minimal
3 “Fixed” – limitation is structural, static, and irreducible and is moderate
4 “Fixed” – limitation is structural, static, and irreducible and is severe

The upper limb ‘Y’ of YMCA was observed in sitting position. In this the child is asked to raise both the upper limbs so as to assume a Y position. SAROMM score is recorded according to the manual.

We determined the Spinal Alignment Score by summing items 1 through 4, the hip score by summing items 5 through 16, the knee score by summing 17 through 20, the ankle score by summing 21 through 24, and the upper extremity score by summing 25 and 26. We determined and record the mean value for each of these scores. Than determined the Range of Motion Score by summing the hip, knee, ankle and upper extremity scores. Calculated the total SAROMM score by summing the Spinal Alignment and the Range of Motion Scores.

Picture 1:- Tools Used For The Study.



Data Analysis

1. ARITHMETIC MEAN

$$\overline{X} = \frac{\sum X}{N}$$

Where, $\overline{X}$ = Arithmetic Mean

$\sum x$ = Sum of the variable

N = The total number of variables.

2. **STANDARD DEVIATION (S.D)**

$$S.D = \sqrt{\frac{\sum (x-x)^2}{N}}$$

Where, x = The individual score

$\overline{X}$ = The mean score

N = the total number of scores

3. PEARSON CORRELATION

$$r = \frac{\sum X \times Y - \frac{\sum X \times \sum Y}{N}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{N}\right]\left[\sum Y^2 - \frac{(\sum Y)^2}{N}\right]}}$$

Where,

X, Y are the variables,

N is the number of samples.

Results:-

Table 5.1:- Distribution Of Different Age Groups.

		No. of subjects	Percent
AGE(YRS)	5.00	11	18.3
	6.00	7	11.7
	7.00	9	15.0
	8.00	8	13.3
	9.00	4	6.7
	10.00	6	10.0
	11.00	8	13.3
	12.00	7	11.7
	Total	60	100.0

Interpretation: The above Table shows the different age groups taken in the study and the frequency of each subject in each age group.

Table 5.2:- Gender.

		No. of subjects	Percent
GENDER	Male	41	68.3
	Female	19	31.7
	Total	60	100.0

Interpretation: the above table shows the number of males and females participating in the study

Table 5.3:- Correlation.

	N	Minimum	Maximum	Mean	Std. Deviation	Median	r value	p value
GMFCS	60	1.00	4.00	1.9500	.69927	2.0000	.538	.000
SAROMM	60	12.00	49.00	27.1667	8.27118	27.0000		HS

Table 5.3 shows that there is a positive correlation between GMFCS and SAROMM

0 <	r	< 0.4(-.4)	Poor correlation
0.41(-.41)<	r	< .6(-.6)	Moderate correlation
.61(-.61)<	r	< .8(-.8)	Good correlation
.81(-.81)<	r	1(-1)	Strong correlation

Table 5.4:- Compare the parameters between GMFCS and gender.

	GENDER	N	Minimum	Maximum	Mean	Std. Deviation	Median	t value	p value
GMFCS	Male	41	1.00	3.00	1.9024	.62470	2.0000	.771	.444
	Female	19	1.00	4.00	2.0526	.84811	2.0000		NS
	Total	60	1.00	4.00	1.9500	.69927	2.0000		

Table 5.4 shows that there is no effect of gender on GMFCS

Table 5.5:- Compare the parameters between SAROMM and GENDER.

	GENDER	N	Minimum	Maximum	Mean	Std. Deviation	Median	t value	p value
SAROMM	Male	41	13.00	49.00	27.0244	8.30207	26.0000	.194	.847
	Female	19	12.00	45.00	27.4737	8.42198	30.0000		NS
	Total	60	12.00	49.00	27.1667	8.27118	27.0000		

Table 5.5 shows there is no effect of gender on SAROMM

Table 5.6:- Correlation between GMFCS and SAROMM according to GENDER.

GENDER		N	Minimum	Maximum	Mean	Std. Deviation	Median	r value	p value
Male	GMFCS	41	1.00	3.00	1.9024	.62470	2.0000	.550	.000
	SAROMM	41	13.00	49.00	27.0244	8.30207	26.0000		HS
Female	GMFCS	19	1.00	4.00	2.0526	.84811	2.0000	.533	.000
	SAROMM	19	12.00	45.00	27.4737	8.42198	30.0000		HS

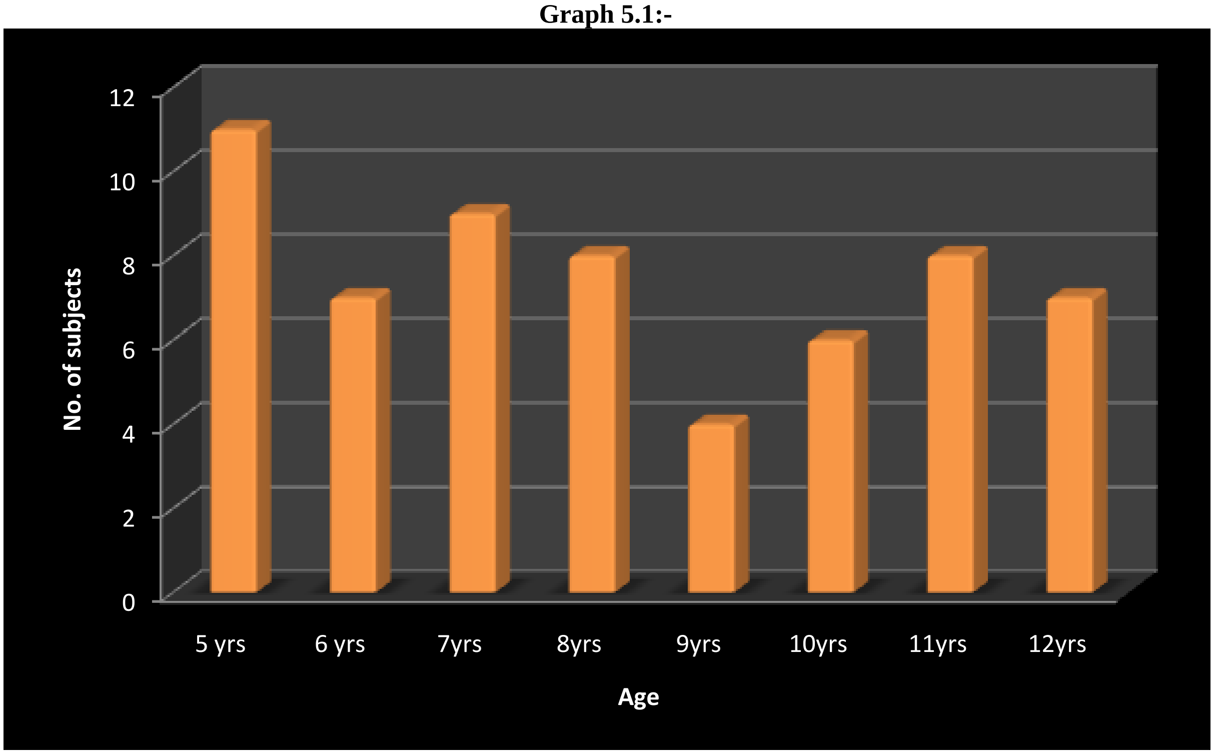
Table 5.6 shows a positive correlation between GMFCS and SAROMM according to GENDER

Table 5.7:- Assess the affect of age on GMFCS and SAROMM.

		Pearson Correlation - r value	p	
AGE(YRS)	GMFCS	-.004	.976	NS
	SAROMM	-.041	.753	NS

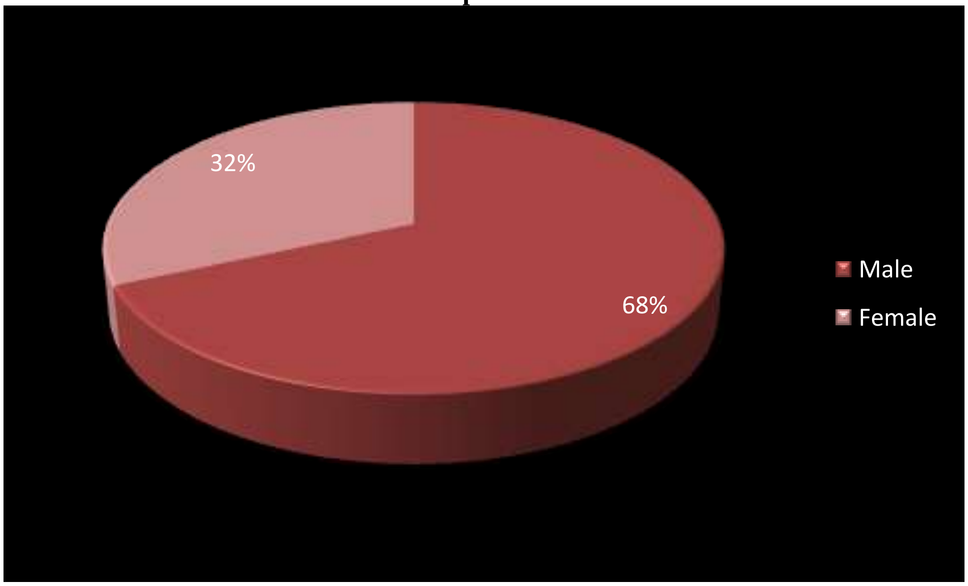
Table 5.7 shows there is no effect of age on GMFCS and SAROMM

Graph 5.1:-



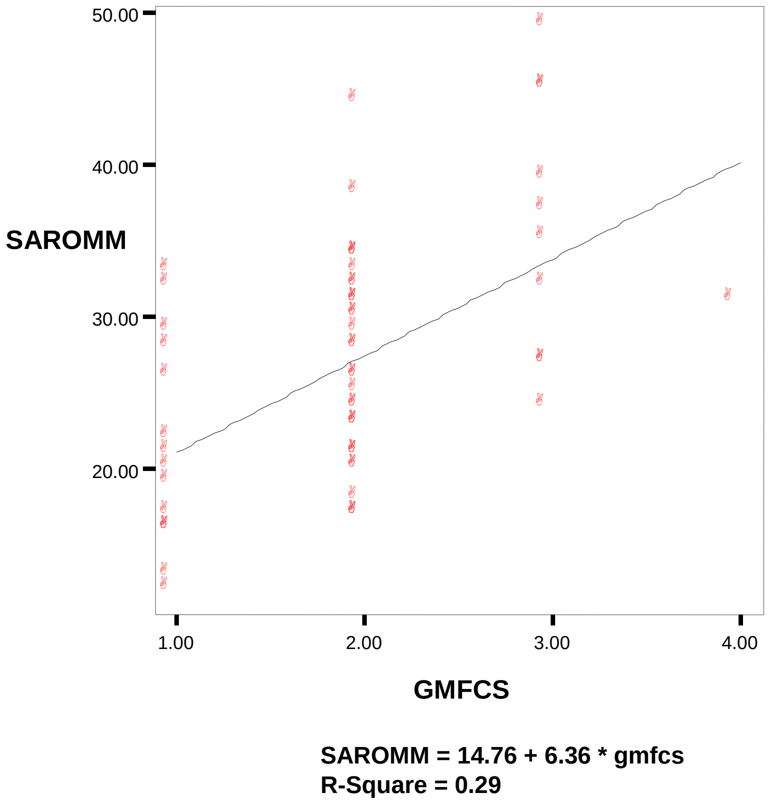
Graph 5.1:- Shows the number of subjects taken in different age groups

Graph 5.2:-



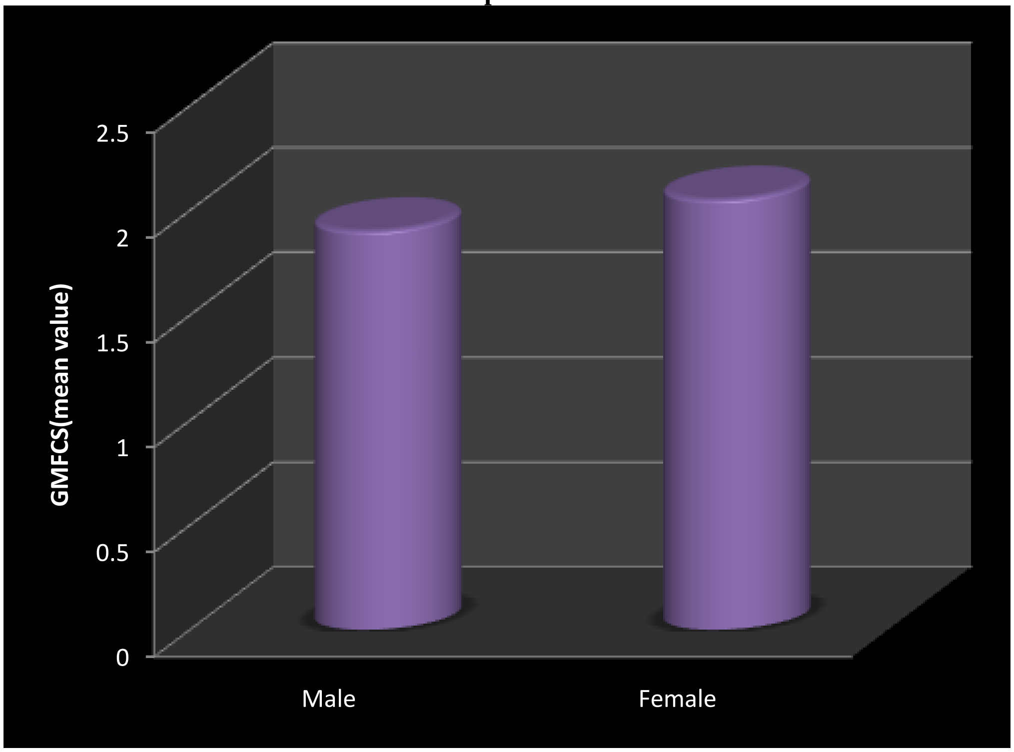
Graph 5.2 shows the percentage of males and females participating in the study

GRAPH: 5.3



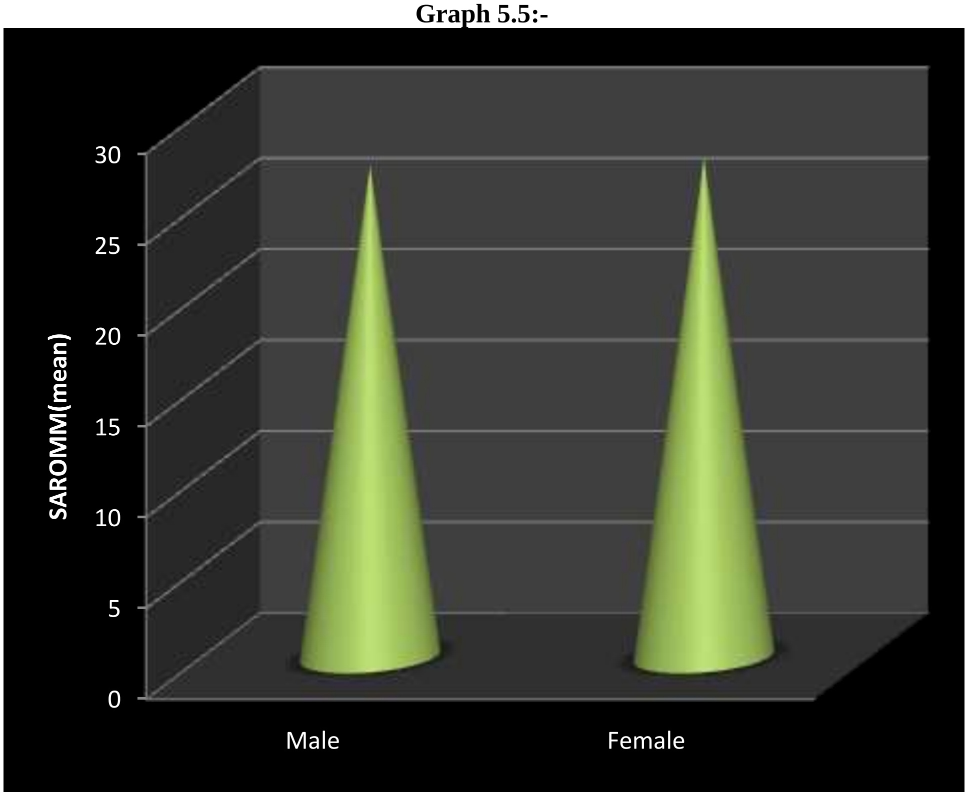
Graph 5.3 shows a positive correlation between GMFCS and SAROMM.

Graph 5.4:-



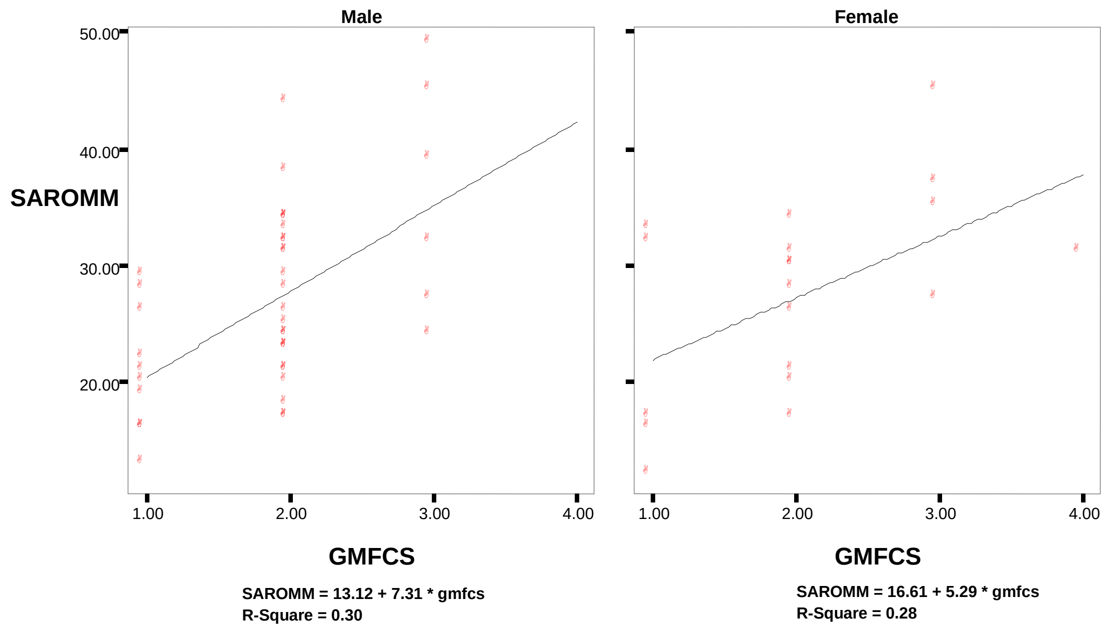
Graph 5.4 shows mean value of GMFCS according to gender.

Graph 5.5:-



Graph 5.5 shows the mean value of SAROMM according to gender

GRAPH 5.6 AND GRAPH 5.7



Graphs 5.6 and 5.7 shows a positive correlation between GMFCS and SAROMM according to GENDER

Discussion:-

Cerebral palsy (CP) refers to the neuromuscular deficit caused by a non-progressive defect or lesion in single or multiple locations in the immature brain resulting in impaired motor function and sensory integrity.[2] CP is the most common cause for motor impairment in childhood and associated with lifelong disability.[27]

Outcome tools are used for patients with CP to measure functional performance as a baseline descriptive assessment, to select treatment goals, and to evaluate outcomes. It is a growing interest in research areas to develop and use reliable, valid, and standardized tools as outcome measures and their relationship with each other for an evidence-based research. The classification systems are meant to discriminate and categorize rather than "assess".[12]

GMFCS was developed as quick and easy to use classification system. The results suggest that gross motor function can be classified accurately by occupational therapists and physical therapists that have knowledge of child's current motor ability. There has been a mixed suggestion from the experts regarding the application of GMFCS among CP children.[8]

SAROMM provide a method that is reliable for estimating overall deviations in spinal alignment and limitations of range of motion when used by rehabilitation practitioners working with children and youth with CP in community setting. Content validity of SAROMM is supported by the iterative process of item generation and refinement with clinicians who have familiarity working with children and adolescents with CP. Construct validity is supported by the evidence that GMFCS level and age are significantly associated with the SAROMM score.[5]

SAROMM is less time consuming than the normal goniometry, where one person is required to conduct the passive technique and then hold the end range, while other person takes a measurement. SAROMM has sufficient validity and reproducibility across raters and over short periods of time.[5]

This is the first study that examines the relationship between GMFCS and SAROMM in spastic CP children. A total of 60 children, medically diagnosed as spastic diplegia within the age group of 5-12 years were taken. The children were screened for inclusion and exclusion criteria and those who fulfilled the criteria were taken in the study.

Children were classified according to the GMFCS level. SAROMM scoring was also done. A correlation was established between these two scales.

The validity of GMFCS was examined using nominal group process and Delphi survey concensus method. The therapists and paediatricians who participated in the nominal group process and Delphi survey consensus methods indicated that a classification system for children with CP has applications for clinical practice, research, teaching and administration. Participants in the nominal group process suggested that a classification system would help professional to present information on a child's current functional abilities and assist families and professionals in planning for a child's need and recommend use of assistive technology.[8]

Wood et al (2000) applied GMFCS on 85 children with CP and concluded that interrater reliability was high (G=0.93). Test-retest reliability was also high (G=0.79). Also they concluded that GMFCS validly predict motor function for children with CP.[6]

Bodkin et al (2003) did a study to evaluated interrater reliability of GMFCS rating made by experienced physical therapists using videotapes. They found that videotape rating is a reliable method. Interrater reliability was 0.84 in children with CP.[9]

Bartlett et al (2005) concluded that the intraclass correlation coefficients reflecting interrater and test-retest reliabilities for the spine and range of motion subscales and the total scores were all above 0.80. Validity was supported by a significant contributions of GMFCS level and age to the SAROMM score (r^2=0.44).[5]

The results shows a positive correlation between GMFCS and SAROMM (r=.538; p=000). Also our results shows that GMFCS is not affected by age (r=-0.004; .p=.976) or by gender (t=0.771; p=0.444). Also SAROMM is not affected by age (r=-0.041; p= 0.753) or gender (t=0.194; p=0.847). But the correlation between GMFCS and SAROMM according to gender is highly significant (Male: r= 0.550; p= 0.000) (Females: r= 0.533; p=0.000).

These scales represents gross motor function domains among which SAROMM includes those items that are most likely to influence the maintenance of basic motor abilities and GMFCS represents self initiated movement with particular emphasis on sitting and walking. None of these scales give any information about other developmental sequence than the gross motor development.

Bodkin et al (2003) compared GMFCS level with two tests of gross motor function- the Peabody Gross Motor Scale and the Vineland Gross Motor Scale; two tests of non-gross motor function- the Bayley Mental Scale and the Vineland communication scale; and a composite, the Vineland Adaptive Behaviour Scale. GMFCS levels were moderately correlated with tests of motor development but not with test of non-motor development. This supports the criterion related validity of the GMFCS stating that GMFCS level is a reflection of motor function. They also found that GMFCS can be used to classify children with CP rather than children with Down syndreome.[9]

Eva Beckung et al (2001) did a study on 176 children with CP and applied GMFCS and BMFM. They found a strong correlation between GMFCS and BMFM, indicating that severity of gross and fine motor function runs in parallel.[4]

Katharina Belhuse Carnehan et al (2007) did a study on 365 children born 1992 to 2001 with CP living in the south of Sweden. GMFCS was evaluated by the child's physiotherapist and MACS by the occupational therapist. They found a poor correlation between two systems as evaluated by the kappa statistics. But in the CP subtypes different associations were found. In hemiplegic CP, manual ability was more limited than gross motor function. The opposite was found in children with diplegic CP. Close association was found between levels in children with dyskinetic CP.[13]

The GMFCS is widely used in clinical and research areas, while SAROMM is gaining attention in the research area. Correlating and utilizing these two scales may provide an easy and practical definition of the levels of gross motor function & deviations in spinal alignment and range of motion limitations in children with CP.

Limitations Of The Study

1. Only spastic diplegic children were included in the study. Children with other types of CP were excluded.
2. Age group taken is small.

Further Recommendations:-

1. Age group can be made larger.
2. Heterogeneous group of subjects can be taken.

Conclusion:-

Our study leads to the following conclusion:
There is a positive correlation between GMFCS and SAROMM.

Summary

GMFCS is a classification system used to classify children into five different levels according to their gross motor function. SAROMM is a scale to determine the spinal alignment and range of motion of a child.

60 subjects who fulfilled the inclusion and exclusion criteria were selected for the study. GMFCS level and SAROMM score for each child was taken.

After analyzing the data the following inference was drawn:
GMFCS and SAROMM are highly significant correlating with each other.

From this we conclude that there is a positive correlation between GMFCS and SAROMM.

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