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DEVELOPMENTAL TRENDS OF SHORT GRAVITATIONAL INSECURITY (SGI) ASSESSMENT AMONG INDIAN CHILDREN

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ABSTRACT

The purpose of this study was to examine the reliability of Short Gravitational Insecurity (SGI) assessment among Indian Children. METHOD:Short Gravitational Insecurity assessment consists of 5 items with two behavioural categories.The Short Gravitational Insecurity Assessment (SGI) was administered to 490 typically developing children in the age group of 3-10 years to determine development trends for SGI assessment for preliminary validation. The SGI assessment was conducted in the standardized format according to the protocol developed for the SGI assessment in a distraction free environment. RESULTS: The results revealed that there was a statistically significant difference in performances between the age groups in Emotional Response (ER), Postural Response (PR) and Total Score (TS) of the SGI assessment. Further, Post hoc analysis revealed that there was a statistically significant difference in one year interval from 3-10 years. CONCLUSION: The present study concluded that SGI has developmental trends. Normative study is recommended to establish a cutoff score for Short Gravitational Insecurity assessment.

KEYWORDS: Gravitational Insecurity, SGI assessment,Developmental trends.

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INTRODUCTION

The vestibular system is fundamental for all our actions. This system is traditionally viewed as having a role, along with the visual system and proprioception, in three major functions: subjective awareness of body position and movement in space; postural tone and equilibrium; and stabilization of eyes in space during head movements[1] (compensatory eye movements) (Fisher, Murray, & Anita,1991). The vestibular receptors are hair cells (cristae) located within the semicircular canals, the utricle, and the saccule of the vestibular labyrinth. The semicircular canals are angular accelerometers that detect changes in the direction and rate of angular acceleration or deceleration of the head. Angular acceleration of the head results in rotary head movements. Within each vestibular apparatus are three semicircular canals, endolymphfilled ducts oriented at right angles to each other so that they represent all three planes in space. When the head is tilted forward 30^0 the horizontal canal is oriented in the horizontal plane, and the two vertical canals are vertical and oriented at right angles to each other. The hairs of the cristae ampullaris of the semicircular canals project into the cupula, a gelatinous wedge that is free to move like a swinging door within the endolymph. When the head moves (accelerates), the inertia of the endolymph causes it to lag behind head movement. The result is the displacement of the cupula and bending of the hairs in the direction opposite head movement. When head movement stops (decelerates), the inertia of the endolymph causes the cupula to “keep going”. The result is displacement of the cupula and bending of the hairs in the same direction that the head had been moving. Several seconds after the head stops moving, or after it has rotated at a constant velocity for several seconds, the endolymph “catches up” and the cupula and the hairs return to their normal resting positions. Because the hair cells in each pair of canals are maximally stimulated by head rotation in the same plane, the hair cells are able to detect movement of the head in the three orthogonal (right angle) planes of three dimensional space. The most efficient stimuli to the semicircular canals are angular, transient (short-term), and fast (high –frequency) head movements of at least 2^0 per second; when the head moves at slower speeds, the endolymph,cupula, and hair cells all move at the same speed as the head[2,3].The utricle is a linear accelerometer that detects linear head movement and head tilt. The utricle is located in the horizontal plane when the head is erect, and the hair cells in each quadrant of the utricle are systematically oriented in a different direction. Embedded in a gelatinous layer over the hair cells are calcium carbonate formation called otoliths, which are denser than the surrounding endolymph. As the head moves, the force of gravity and linear acceleration act on this otolithic membrane to displace the hairs of the hair cells. These hair cells that are aligned in the direction of gravitational pull, head tilt, or linear acceleration are maximally stimulated. Thus, systematic variation in the orientation of the utricular hair cells results in the utricle also being able to detect head movement or head tilt (position) in the three orthogonal planes of three-dimensional space[4].Gravitational Insecurity (GI) is described as an abnormal anxiety caused by dysfunction in the integration of sensation that arises when the vestibular system is stimulated by head position or movement[5]. The pull of gravity most of us trust and take for granted is perceived by this child as a primal threat to survival. This condition is characterized by oververt fear to movement, height or change in head position. A child with gravitational insecurity has an anxiety when feet leave the ground, fear of falling or being moved suddenly, dislike being upside down and uneasiness when walking on uneven surfaces[6]. Child overreacts with a fight or flight response. The fight response plays out as negative, defiant behaviour, particularly when the child is passively moved. Child may resist being picked up, rocked, or pushed in a stroller. The child may become angry and stubborn when someone suggests riding in the car or sliding down a hill[7].Ganapathy Sankar & Prema standardised Gravitational Insecurity assessment among Indian children[8] in 2013. The Short Gravitational Insecurity (SGI) Assessment is a promising clinical tool for objectively identifying children with gravitational insecurity. Short gravitational assessment has 5 items with 2 behavioural categories.The reliability of SGI assessment was examined.

Convergent,discriminant validity has been reported[9]. Developmental trends for SGI were not examined. The purpose of this study was to examine developmental trends for Short Gravitational Insecurity assessment.

METHODOLOGY

Ethical clearance was obtained from SRM University Research, Ethical committee to carry out this research work.

SCREENING CRITERIA

Inclusion Criteria

- No behavioral characteristic of GI
- No educational remediation
- Age group of 3 -10 yrs
- Both genders

Exclusion Criteria

- Children with physical handicap
- Children with comprehension problem

INSTRUMENTS USED

- Short Gravitational Insecurity(SGI) Assessment

Short Gravitational Insecurity Assessment

Gravitational Insecurity assessment was standardized among Indian children[8] in 2013. Ganapathy Sankar & Prema study results revealed that 5 items with 2 behaviour categories was sufficient to measure gravitational insecurity in children.This new version is called Short Gravitational Insecurity (SGI) assessment. SGI has acceptable level of interrater reliability (ICC=0.90, 0.93, 0.96 for ER, PR and total test score) and test–retest reliability (ICC=0.93, 0.86, 0.94 for ER, PR and total test score). Internal consistency (a=0.96) and split - half reliability (r=0.68) of SGI assessment items were good[9]. Convergent validity,discriminant validity has been reported. The administration time is about 10-15 minutes.

(a) Equipments Used

Equipment required for GI assessment

- Scoring sheets
- Pencil
- Floor mat
- Meter / yard stick
- Standard therapy ball
- Standard adult chair
- Tilt board
- Masking tape

(b) Scoring Procedure

The scoring system is a 3 point scoring system with 2 behavioral categories.
The behavioral categories are

- Emotional response
- Postural response

Research Design

This study involved observation of all children at one specific point of time to identify developmental trends for SGI assessment. The follow up is not required. Hence it is a quantitative research-cross sectional study.

Participants

Typically developing children were recruited from a mainstream school in Chennai,Tamilnadu,India.

The point scoring is

- 3 - Typical response
- 2 - Moderate / Mild GI
- 1 - Definite GI

DATA COLLECTION PROCEDURES

The purpose of the study was explained to the appropriate authorities of the schools involved and informed consent form was obtained from parents. Testing was conducted in seven schools in Chennai by investigator. The SGI assessment was conducted in the standardized format according to the protocol developed for the SGI assessment in a distraction free environment with good ventilation in separate rooms. The directions were given for each task and children were requested to complete the tasks two times. Average score was taken for final computation. The room was covered by "plinth" in order to avoid injury during SGI assessment task like supine on therapy ball-active,height jump and forward roll etc. The Short Gravitational Insecurity Assessment (SGI) was administered to 490 typically developing children in the age group of 3-10 years to determine development trends for SGI assessment for preliminary validation.

RESULTS

Table 1

Developmental trends for SGI assessment- Emotional Response (ER)

Age interval	Mean	SD	F(6,483) df(k-1,n-k)	Level of significance
3.0- 3.11	9.6	1.087	121.22	0.001
4.0- 4.11	10.7	1.485		
5.0- 5.11	11.1	1.025		
6.0- 6.11	11.8	0.971		
7.0- 7.11	12.9	0.471		
8.0- 8.11	13.8	0.363		
9.0- 9.11	14.7	0.203		

p<0.001

F - ANOVA
df - Degree of freedom
k - Number of populations
n - Total number of observations

Table 1 and figure 1 indicates that One way ANOVA was used to find out the significant difference in Emotional Response of SGI assessment between the age groups (3-10 years). Results showed that there was a statistically significant difference (F (6, 483) = 121.22; p<0.001) between the age groups at 0.001 level.

Table 2

Developmental trends for SGI assessment- Postural Response (PR)

Age interval	Mean	SD	F(6,483) df=(k-1,n-k)	Level of significance
3.0- 3.11	8.9	1.182	195.22	0.001
4.0- 4.11	9.6	1.075		
5.0- 5.11	10.5	1.188		
6.0- 6.11	11.3	1.045		
7.0- 7.11	12.04	1.017		
8.0- 8.11	12.9	0.892		
9.0- 9.11	14.1	0.652		

p<0.001

F - ANOVA
df - Degree of freedom
k - Number of populations
n - Total number of observations

Table 2 and figure 2 indicates that One way ANOVA was used to find out the significant difference in Postural Response of SGI assessment between the age groups (3-10 years). Results showed that there was a statistically significant difference (F (6, 483) = 195.22; p<0.001) between the age groups at 0.001 level.

Table 3
Developmental trends for SGI assessment-Total Score(TS)

Age interval	Mean	SD	F(6,483) df=(k-1,n-k)	Level of significance
3.0- 3.11	18.5	1.796	324.22	.001
4.0- 4.11	20.3	2.163		
5.0- 5.11	21.6	2.799		
6.0- 6.11	23.1	2.655		
7.0- 7.11	24.94	1.431		
8.0- 8.11	26.7	1.147		
9.0- 9.11	28.9	0.721		

p<0.001
F - ANOVA
df - Degree of freedom
k - Number of populations
n - Total number of observations

Table 3 and figure 3 indicates that One way ANOVA was used to find out the significant difference in Emotional Response of SGI assessment between the age groups (3-10 years). Results showed that there was a statistically significant difference (F (6, 483) = 324.22; p<0.001) between the age groups at 0.001 level.

DISCUSSION

Developmental trends of Short gravitational insecurity assessment

A developmental trends in Short Gravitational Insecurity assessment was examined. The results revealed (table 1,2&3) that there was statistically significant difference in performances between the age groups in Emotional Response (ER), Postural Response (PR) and Total Score (TS) of the SGI assessment. Further, Post hoc analysis revealed that there was a statistically significant difference in one year interval from 3-10 years and positive correlation between age and SGI assessment. These findings supported differences in performance among younger and older children, reflecting developmental trends of Short Gravitational Insecurity assessment. Children who experience sport activities will have good balance and gross motor skills than the others who don't participate in it. Children's sports experience should make them feel good and have confidence in themselves[10]. As age increases children's participation in various gross motor activities increases. They can develop in gross motor skills along which their emotional responses

Table 4
Comparison of developmental trends of SGI assessment with previous studies

Authors	Age group	GI assessment version	Results
May Benson & Koomar,2008	2-5 years	Revised	Children performance was increase with age
Ganapathy & A.Prema ,2011	3-10 years	Revised	Significant difference in performance between the age groups
Present study	3-10 years	SGI assessment	Significant difference the in performance between age groups

develop. This may influence the children's emotional response in various age intervals on GI assessment. Children who are practicing dance, tennis, karate and other corresponding activities, will have good balancing skills. Kathleen and Getchell found that balance, somersault, one leg standing, and stair climbing activities have developmental phases. Therefore, these literatures support the current findings which determined that there was an increase in children's performance on GI assessment as when the age increases.

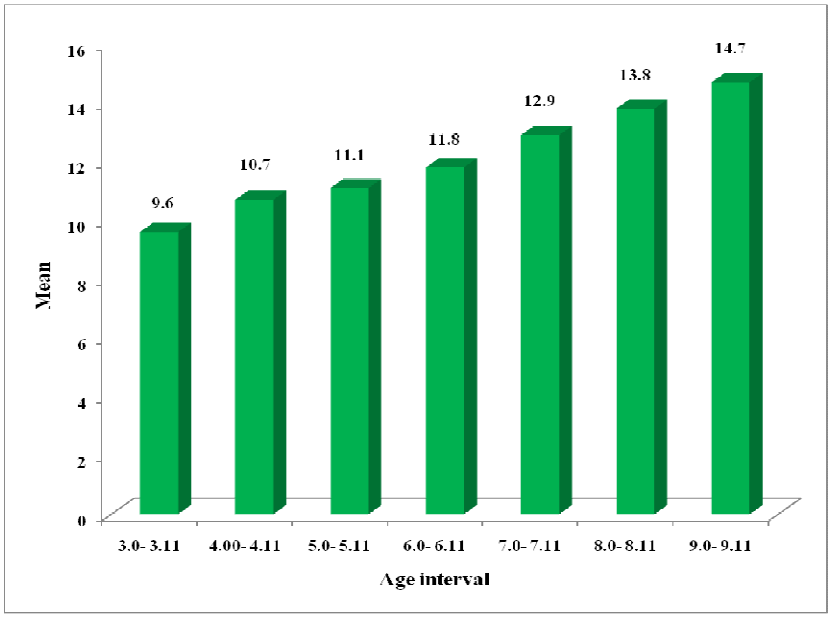

Figure 1
Developmental trends of SGI assessment-Emotinal response

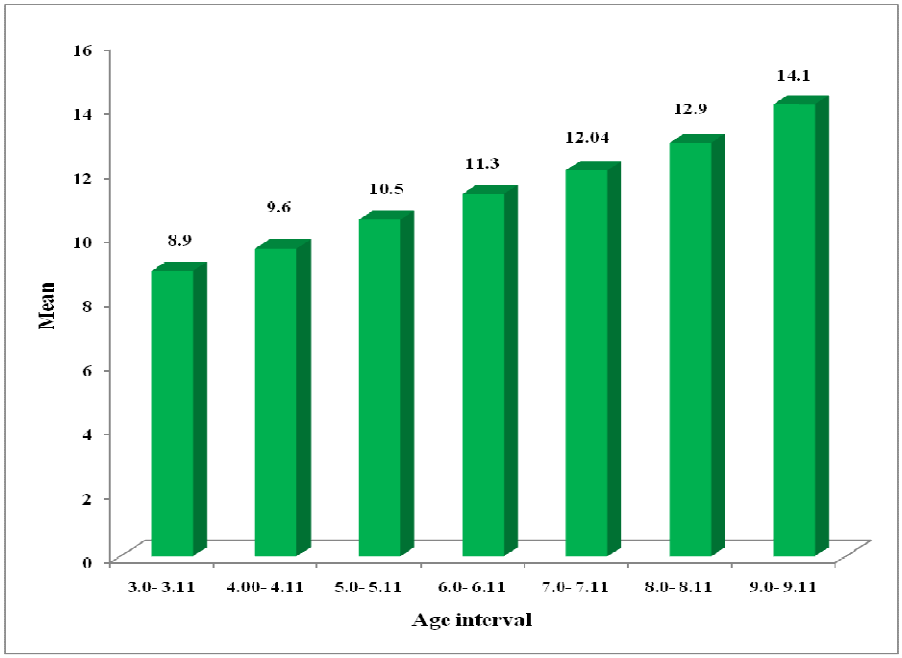

Figure 2
Developmental trends of SGI assessment-Postural response

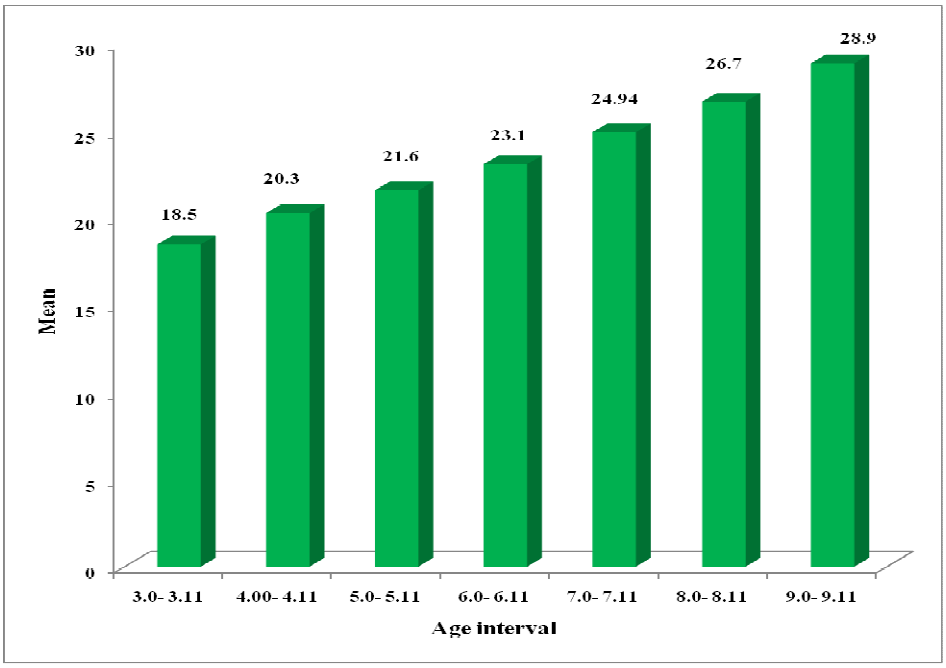

Figure 3
Developmental trends of SGI assessment-Total score

Developmental trends for gravitational insecurity assessment –revised version[11] was done with 48 typically developing children in the age group of 2-4.11 years. The results showed that there was significant difference between the age group on gravitational insecurity assessment, reflecting a developmental trend for GI assessment (revised version). In 2011, 450 typically developing children were included from age group of 3 to 10 years to determine developmental trends for GI assessment-revised version[12]. The results revealed that there was statistically significant difference in performances between the age groups in Emotional Response ($F(8, 441) = 122.772$; $p<.001$), Postural Response ($F(8, 441) = 319.692$; $p<.001$) and Total Score ($F(8, 441) = 340.027$; $p\leq.001$) of GI assessment (revised version).

CONCLUSION

Gravitational Insecurity is an irrational fear response exhibited when activities challenged against gravity are related to change of head position, movement on an unstable surface or limiting the level of visual input are introduced to the client. In Indian context, occupational therapist has done Gravitational Insecurity assessment through clinical observation, parent or caregiver report. There is no objective assessment tool to measure gravitational insecurity in children. Short Gravitational Insecurity assessment tool is the first objective measurement tool in India to measure gravitational insecurity in children. The current study results revealed that SGI has developmental trends and it can be used as an assessment tool, research tool and also as an outcome measurement. Normative study should be done to establish a cutoff score for Short Gravitational Insecurity assessment. Effectiveness of Short Gravitational Insecurity assessment should be evaluated in experimental research.

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