

Validity of Short Gravitational Insecurity Assessment among Indian Children

Ganapathy Sankar U.¹, Prema .A²

¹SRM college of Occupational Therapy, SRM University, SRM Nagar, Kattankulathur, Kancheepuram District, TamilNadu, Pin Code-603203,India

²SRM Medical College Hospital & Research Center, Department of Paediatrics, SRM University, SRM Nagar, Kattankulathur, Kancheepuram District, TamilNadu, Pin Code-603203, India

Abstract: *The purpose of this study was to examine validity of Short Gravitational Insecurity (SGI) assessment among Indian Children. Short Gravitational Insecurity assessment consists of 5 items with two behavioural categories. The Short Gravitational Insecurity Assessment (SGI) and movement sensitivity section of Short Sensory Profile was administered to 50 children with Gravitational Insecurity to establish convergent validity of SGI. Two hundred children with GI and matched typically developing children participated to examine discriminant validity of SGI. The results revealed that there was moderate correlation between SGI and movement sensitivity section of SSP. Further, there was statistically significant difference in performances between GI and typically developing children. The present study concluded that convergent validity and discriminant validity of SGI was good. It can be used as assessment tool as well as outcome measure to evaluate effectiveness of occupational therapy intervention program.*

Keywords: Gravitational Insecurity, SGI assessment, validity, convergent validity, discriminant validity

1. Introduction

Gravitational Insecurity (GI) is defined as an abnormal anxiety due to dysfunction in the integration of sensation that arises when the vestibular system is stimulated by head position or movement. Gravitational Insecurity is overresponsivity to vestibular system. A child with Gravitational Insecurity has fear in uneven surfaces, 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; uneasiness when walking on uneven surfaces [1].

Gravitational insecurity has been postulated to be due to poor modulation of otolithic input. GI is a discrete disorder that may occur in persons with normal postural ocular responses. Research studies [2] hypothesized that GI is due to decreased vestibulocerebellar functioning; this leads to decreased vestibuloocular integration, resulting in high arousal and apparently irrational limbic system based fear responses to sudden or disorienting movement experiences. Researchers have supported the relationship of vestibulocerebellar dysfunction with increased arousal state, anxiety, and fear responses as characteristics of gravitational insecurity. Disorienting to perceptual experiences in children particularly to depth perception; lack of visual input during motor task; difficulty integrating visual, vestibular, and proprioceptive input are other factors contributing to GI [3]. Lastly, recent researches have also evidenced that increased sensitivity to the vestibular stimulation or visual – vestibular conflict can result in motion sickness [4].

1.1 Differences between Gravitational Insecurity, Intolerance to Movement and Postural Insecurity

Gravitational Insecurity is theoretically distinguished from intolerance to movement and postural insecurity. She explained intolerance to movement with autonomic nervous system reactions and postural insecurity due to decreased postural mechanism. Children with Intolerance to movement exhibits distress after nonthreatening stimulation of the semicircular canal of the inner ear. It is usually accompanied by nausea, vertigo, or headache. Children with postural insecurity exhibits extreme caution experienced as a result of decreased postural ability when completing physical challenges involving postural strength and stability. Sensory motor deficits lead to motor coordinative instability leading to postural insecurity. Postural Insecurity children completely lack the fear response associated with gravitational insecurity [5].

1.2 Need for the Study

Gravitational Insecurity is one type of sensory modulation disorder and it is commonly seen in Autism, Attention Deficit Disorder, Learning disability. In Indian context, occupational therapist has done Gravitational Insecurity assessment through clinical observation, parent or caregiver report [6]. There is no objective assessment tool to measure gravitational insecurity in children. May-Benson & Koomar [7] developed an objective assessment tool to measure gravitational insecurity in children. Gravitational Insecurity assessment has 15 items with three behavioural categories. It required 45-55 minutes to administer the test. Revised version of Gravitational insecurity assessment has 9 items with 2 behavioural categories and it required 30-40 minutes to complete the assessment. Gravitational insecurity is one of the vestibular overresponsivity problem. But GI assessment required 30 to 40 minutes and it was time consuming. May-Benson & Koomar also suggested that GI assessment has to

be refined before it may be routinely used. Therefore, there is need to shorten the GI assessment and establish good reliability and validity. Ganapathy Sankar & Prema [6] standardized Gravitational Insecurity assessment among Indian children in 2013. The new Indian version is called Short Gravitational Insecurity (SGI) assessment. Interrater reliability and test-retest reliability of SGI [8] was examined. But validity of Short Gravitational Insecurity assessment was not examined. Hence the current study was carried out to establish validity for Short Gravitational Insecurity (SGI) assessment among Indian children. The purpose of this study was to examine convergent and discriminant validity of SGI assessment.

2. Methodology

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

2.1 Research Design

Quantitative research-cross sectional study.

2.2 Participants

Gravitational Insecurity children was selected randomly from various therapy centre and special schools in Chennai, Tamil nadu, India based on screening criteria. Typically developing children were recruited from a mainstream school in Chennai, Tamilnadu, India.

2.3 Screening Criteria

Inclusion Criteria:

(i) **Gravitational Insecurity children** : Children were identified by primary investigator in selected special school and therapy centre based on their behaviour during the occupational therapy intervention sessions mainly demonstrating fearful response in any two of the following behavioural characteristics of Gravitational Insecurity:(1)Movement on an unstable surface;(2)Unexpected of quick movement by another person;(3)Change of head position;(4)Change of head position with feet moved off a stable surface;(5)Static position or movement on a high surface;(6) Disorienting to lack of visual input.In addition, the following criteria were included, Age group of 5- 10 yrs; Both genders. Children with physical handicap and children with comprehension problem were excluded from the study.

(ii) **Typically Developing Children:** children with no behavioral characteristic of GI;No educational remediation;Age group of 5 -10 yrs;Both genders.

Exclusion Criteria (common for both groups): Children with physical handicap and children with comprehension problem were excluded from the study.

2.4 Instruments Used

(i) Short Gravitational Insecurity (SGI) assessment

(ii) Movement Sensitivity Section of Short Sensory Profile (SSP)

(i) Short Gravitational Insecurity Assessment (SGI):

Short Gravitation Insecurity Assessment (SGI) was developed from original version of GI assessment and standardized among Indian children in 2013. It is an individually administering test . It consists of 5 items with two behavioural categories. The administration time is about 10-15 minutes. Intra-class correlation coefficient for SGI assessment was 0.959 and it 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 ($\alpha=0.96$) and split - half reliability ($r=0.68$) of GI assessment items [8] were good.

Equipment's Used

SGI assessment, Scoring sheets, Pencil, Floor mat, Meter / yard stick, Standard therapy ball, Standard adult chair, Tilt board, Masking tape.

Scoring Procedure

The scoring system is a 3 point scoring system with 2 behavioral categories. The behavioral categories are Emotional response and Postural response. The point scoring is 3 - Typical response; 2 - Moderate / Mild GI; 1 - Definite GI

(ii) Movement Sensitivity Section of Short Sensory Profile (SSP)

SSP is a 38 items care giver questionnaire in 7 sections that evaluates functional behaviors related to sensory processing disorders [9]. The Short Sensory Profile was developed from extensive research and development on the Sensory Profile [10]. Items include functional behaviors that are symptomatic of sensory a processing disorder that demonstrates the higher discriminative power of atypical sensory processing among the entire item from the long version. It is standardized among 1200 children. The total administration time is 10 min. It is a 5 point scoring system. Total score is most indicative of sensory integration dysfunction. The Movement Sensitivity section consisted of 3 items. The administration time is 2 min. The total score of the movement sensitivity section is indicative of a vestibular hyper sensitivity indicating sensory modulation dysfunction.

Reliability and validity of the tool are excellent. Internal reliability of the Short Sensory Profile total test is > 0.95 for a sample of children with and without disabilities (Cronbach's alpha) and subscale reliabilities range from .70 to .90 across three samples . Inter-scale correlations were moderate in size, ranging from 0.25 to 0.76, suggesting that the subscales measure unique dimensions. Discriminant validity was demonstrated by comparing children with sensory processing disorders and an age and gender matched typically developing group. Convergent validity was determined by comparing the Short Sensory Profile scores to physiological evidence of sensory processing disorders: Abnormal Short Sensory Profile scores were significantly associated with abnormal electrodermal

reactivity in response to sensory stimulation [9].The scoring is recorded as: 5- never; 4- seldom;3- occasionally; 2- frequently; 1- always.

2.5 Data Collection Procedure

The purpose of the study was explained to the appropriate authorities of the special schools and therapy centres involved and informed consent form was obtained from parents. Pediatric occupational therapist with 5 years’ experience was requested to identify GI children in their centre based on behavioural characteristic of GI children. Further it was confirmed by investigator. Testing was conducted at seven therapy centres and three special schools in Chennai by investigator. The SGI assessment was conducted in the standardized format according to the protocol developed for the SGI Assessment in distraction free environment with good ventilation. 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 GI assessment task like supine on therapy ball-active and forward roll etc.

SGI was administered to 50 Gravitational Insecurity children. The Movement Sensitivity Section of the Short Sensory Profile (SSP) was obtained from the parents of the same 50 GI children for determining convergent validity of SGI assessment. Two hundred and twenty four GI children were selected to identify discriminant validity of SGI assessment but 24 children were excluded due to poor comprehensive ability. Short Gravitational Insecurity assessment (SGI) was administered to 200 Gravitational insecurity children and matched typically developing children for determine discriminant validity of SGI assessment.

2.6 Data Analysis

Karl Pearson Correlation (r) was used to correlate the Behavioral Response of SGI assessment and the Movement Sensitivity Section of SSP for establishing convergent validity. One way ANOVA was used to compare the GI children performance with matched typically developing children for establishing discriminant validity of SGI assessment.

3. Results

Table 1: Correlation between SGI Assessment (Emotional Response , Postural Response , Total Score) and Movement Sensitivity Section of SSP

Components	Pearson Correlation (r)
Emotional response (ER)	0.5
Postural response (PR)	0.2
Total score (TS)	0.5

The results show that there is moderate correlation between ER-Movement Sensitivity Section of SSP, weak correlation between PR-Movement Sensitivity Section of SSP and moderate correlation between TS-Movement Sensitivity

Section of SSP (r = 0.5, p ≤ 0.01; r = 0.2; r = 0.5, p ≤ 0.05 respectively).

Table 2: Comparison of GI children and matched typically developing children performance on SGI assessment- Emotional Response (ER)

Group	Mean	Standard deviation	F(1,198) df(k-1,n-k)	Level of significance
GI	7.54	1.074	3431.607	0.000
TDC	14.26	1.215		

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

The results showed that there is statistically significant difference (F(1,198) =3431.607;p<0.001) in performance of SGI assessment-Emotional Response between GI and typically developing children.

Table 3: Comparison of GI children and matched typically developing children performance on SGI assessment- Postural Response (PR)

Group	Mean	Standard deviation	F df(k-1,n-k)	Level of significance
GI	6.41	1.089	1567.244	0.000
TDC	13.33	2.219		

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

The results showed that there is statistically significant difference (F(1,198)=1567.244;p<0.001) in performance of SGI assessment-Postural Response between GI and typically developing children.

Table 4: Comparison of GI children and matched typically developing children performance on SGI assessment- Total Score (TS)

Group	Mean	Standard deviation	F df(k-1,n-k)	Level of significance
GI	13.94	1.820	3381.175	0.000
TDC	27.58	2.773		

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

The results showed that there is statistically significant difference(F(1,198)=3381.175;p<0.001) in performance of SGI assessment-Total score between GI and typically developing children.

4. Discussion

In order a test to be considered as a valid measure, it must be reliable, or consistent in its measurement. Additionally a test must demonstrate content validity, convergent validity,

construct validity and discriminant validity. The current study examined convergent validity and discriminant ability of SGI assessment.

4.1. Convergent Validity

Convergent validity was examined by comparing the results of the SGI Assessment with Movement Sensitivity Section of the Short Sensory Profile. Karl Pearson Correlation Coefficient (table 1) was done to analyze the convergent validity which found a moderate correlation with Emotional Response category and Total score of SGI Assessment. Revised version of Gravitational insecurity assessment [11] was compared with movement sensitivity section of short sensory profile. The results found that movement sensitivity section of SSP has weak correlation with postural response and moderate correlation with emotional response and total score of GI assessment. The present findings also supported by this result.

Table 5: Comparison of GI assessment with movement sensitivity section of SSP

Authors	Samples	GI assessment version	Results
Ganapathy & Prema.A, 2012	28 GI children	Revised	r= 0.5 for ER, r = 0.2 for PR, r = 0.4 for TS
Present study	50 GI children	SGI assessment	r= 0.5 for ER, r = 0.2 for PR, r = 0.5 for TS

This finding is reasonable as all items of the Movement Sensitivity Section of the SSP represent the emotional reaction of the child during a movement activity. Similarly, the Postural Response category was weakly correlated with the Movement Sensitivity Section. Because there are no items examining the postural reactions of the child in this section of the SSP.

4.2 Discriminant validity of SGI assessment:

Gravitational Insecurity children and matched typically developing children performance on Short Gravitational Insecurity assessment were compared to establish discriminant validity of SGI assessment. The results found (table 2, 3 &4) that children with Gravitational Insecurity scored significantly lower than the children who were typically developing. Further analysis revealed that there was statistically significant difference between GI children and typically developing children performance on emotional response, postural response and total score of the GI assessment. GI children showed anxiety and fear response while performing task in SGI assessment due to sensory conflict. It may affect their emotional and postural response score in SGI assessment and got lower mean score in [$F(1, 198) = 3431.607, p < .0001$; typical $M = 14.26$; GI $M = 7.54$] emotional response, postural response [$F(1, 198) = 1567.244, p < .0001$; typical $M = 13.33$; GI $M = 6.41$], and total score [$F(1, 198) = 3381.175, p < .0001$; typical $M = 27.58$; GI $M = 13.94$] of SGI assessment compare to typically developing children. The results of the study concluded that Short Gravitational Insecurity assessment correctly discriminate GI children from typically developing

children. The results of this study was consistent with previous studies[7,12].

Table 6: Comparison of GI children and TDC performance on GI assessment

Authors	Samples	GI assessment version	Results
May-Benson & Koomar, 2008	18 GI children & matched TDC	Revised	Total scores of the children with gravitational insecurity to be significantly lower than TDC
Present study	200 GI children & matched TDC	SGI assessment	GI children scored low in ER, PR & TS than TDC

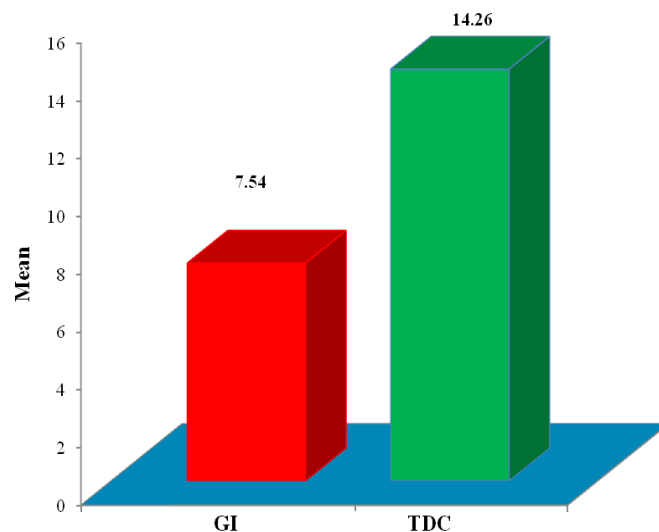


Figure 1: Comparison of GI and TDC performance on SGI assessment-Emotional response

Discriminant validity of gravitational insecurity assessment-original version [7] was examined by comparing 18 gravitational insecurity children performance on GI assessment (original version) with matched typically developing children. One way analysis of variance found the total scores of the children with gravitational insecurity to be significantly ($F(1, 34) = 38.035, p < .000$; typical $M = 132.6$, GI $M = 123.9$) lower than those of the children who were typically developing. The current study findings also consistent with this study results.

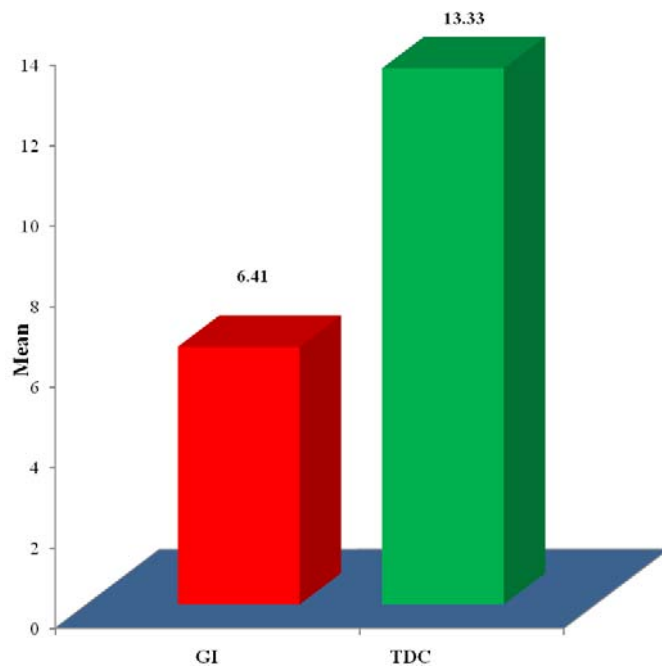


Figure 2: Comparison of GI and TDC performance on SGI assessment-Postural response

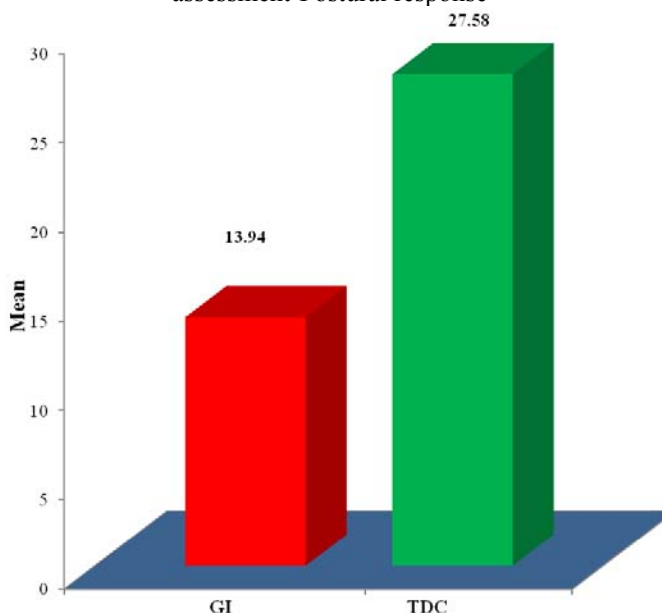


Figure 3: Comparison of GI and TDC performance on SGI assessment-Total score

5. Conclusion

Gravitational Insecurity is a common sensory modulation disorder which directly hampers the performance area of the child in play and other daily living activities. Sensory integration therapy focusing on reducing the sensory modulation disorders is one of the areas where occupational therapists have a major role. The current study examined validity of Short Gravitational Insecurity assessment among Indian children. The results of this study concluded that SGI assessment good convergent validity and discriminant validity. In India, SGI is the first objective measurement tool to measure gravitation insecurity problem in children. It can be used as assessment tool as well as outcome measure to evaluate effectiveness of occupational therapy intervention program. Further research is recommended to establish

cutoff score for SGI assessment and to examine other types of validity of SGI assessment. Effectiveness of Short Gravitational Insecurity assessment is recommended in experimental research.

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Author Profile

Dr. U. Ganapathy Sankar, MOT (Paediatrics), Ph.D, Assistant Professor, SRM College of Occupational Therapy ,SRM University, Kattankulathur, Kancheepuram District, Tamilnadu .pin 603 203.India.

Dr. A. Prema, MD (Paediatrics), Ph.D, Professor & Head of the Department, Department of Pediatrics, SRM Medical college hospital & Research Center, SRM University, Kattankulathur, Kancheepuram District, Tamilnadu .pin 603 203.India.

Corresponding Author

Dr. U. Ganapathy Sankar, MOT (Paediatrics), Ph.D, Assistant Professor, SRM College of Occupational Therapy ,SRM University, Kattankulathur, Kancheepuram District, Tamilnadu .pin 603 203.India. email id:ganapathysankar8@gmail.com