



GRAVITATIONAL INSECURITY (GI) ASSESSMENT AMONG INDIAN CHILDREN

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ABSTRACT

This study examined the Gravitational Insecurity (GI) assessment tool construction among Indian children. The GI assessment consist of nine items related on two behavioral categories- Emotional response and Postural responses. Convenience sapling procedure was done for the selection of samples. Group I included 200 childrens with Gravitational Insecurity issue. Group II included typically developing, matched by age and gender with Group I. The result revealed that all the nine items were discriminated statistically at 100% level. Finally classification analysis revealed that fine tasks were sufficient to identity GI in childrens. This results concluded that revised version of GI assessment is a less time consuming and it can be used as an assessment tool as well as outcome measure for intervention.

KEYWORDS: Gravitational Insecurity, Emotional response, Postural responses, Sensory dormancy.



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INTRODUCTION

The term sensory integration dysfunction was first used by Ayres in 1963. She theorized that impaired sensory processing might result in various functional problems, which she labeled Sensory Integration Dysfunction (Ayres, 1972b). According to the new nosology a classification was proposed based on previous work by many theorists and researchers (eg, DeGangi, 2000; Dunn, 2001; Mulligan, 1998). It proposes that the diagnosis of Sensory Processing Disorder (SPD) rather than Sensory Integration Dysfunction (Miller, 2007). Sensory Processing is the term that refers to the way in which the central and the peripheral nervous system manage incoming sensory information including the reception, modulation, integration and organization of sensory stimuli (Lane, Miller 2000). It refers to our ability to take in sensory information through our senses, organize, and interpret that sensory information and make a meaningful response. The neurological disorganization resulting in SPD occurs in three different ways: the brain does not receive messages due to a disconnection in the neuron cells; sensory messages are received inconsistently; or sensory messages are received consistently, but do not connect properly with other sensory messages. When the brain poorly processes sensory messages, it results in inefficient motor, language, or emotional output. According to Sensory Integration International (SII), a non-profit corporation concerned with the impact of sensory integrative problems on people's lives, the following are some signs of sensory processing disorder:

- Oversensitivity to touch, movement, sights or sounds
- to touch, movement, sights or sounds
Underreactivity
- Tendency to be easily distracted
- Social and/or emotional problems
- Activity level that is unusually high or unusually low
- Physical clumsiness or apparent carelessness
- Impulsive, lacking in self-control
- Difficulty in making transitions from one situation to another
- Inability to unwind or calm self

- Poor self concept
- Delays in speech, language, or motor skills
- Delay in academic achievement. SPD is the global term that includes three primary groups (Lucy et al, 2007).
- Sensory modulation disorder (SMD)
- Sensory discrimination disorder (SDD)
- Sensory based motor disorder (SBMD)

Sensory Modulation Disorder (SMD)

Sensory modulation refers to as a specific component of sensory integration, it is the capacity to regulate and organize the degree, intensity, and nature of responses to sensory input in a graded and adaptive manner (Lane, Miller & Hanft, 2000). Sensory Modulation Disorders (SMD) is impairments in regulating the degree, intensity and nature of responses to sensory input, resulting in considerable problems with daily roles and routine. Behavioral patterns demonstrated by individuals with sensory modulation dysfunction include hyper-responsivity, also referred to as "sensory defensiveness", hypo-responsivity or "sensory dormancy" (Knickerbocker, 1980) as well as patterns of fluctuating responsivity (Lane, Miller & Hanft, 2000). Parham and Mailloux (1995) list five key limitations commonly demonstrated by children with disturbances in sensory modulation:

1. Decreased social skills and participation in play
2. Disturbance in self confidence and self esteem
3. Difficulty with daily life skills and at school
4. Anxiety disturbances in attention and disturbances in the ability to regulate reaction to others
5. Disturbances in skill development

Gravitational Insecurity

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 (Ayres, 1979). 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. Ayres (1979) specifically identified a unique sub group of children with sensory integrative dysfunction who exhibit excessive emotional reaction in response to changes in head movement or head position as having a condition called as gravitational insecurity. She states that this type of child feels "fear, anxiety, and distress whenever he is in a position to which he is not accustomed or when he tries to assume a such a position or when he tries to control his movement or position but comes from deep inside his brain where words and rewards have no effect." Shaffer (1979) described GI as a primal threat or fear as the emotional response experienced when ones' ability to naturally maintain balance against gravity is disturbed. He stated that poor vestibular integration results in a child's life experience informing that the world is fraught with possible destruction. 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

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 (Karanowitz, 1998) The flight responses play out as extreme caution or avoidance of movement. The child prefers keeping her head up and feet down, firmly planted. The child avoids riding a bicycle, sliding and swinging. The child may be fearful on unstable surfaces, such sandy beach or climbing net at playground. The child may avoid novel experiences such as visiting friend's house, for any place other than home is unpredictable. The child with terror tends to be inflexible and controlling. The child often has social and emotional problem. The child is always worried as they seem to be vulnerable when around other people. The result is that these children can never get organized for other tasks, such as playing and socializing. These children experience

exaggerated emotional response to antigravity movement, way out of proportion with the actual possibility of falling. These children prefers to stay low to the ground lying down or seated rigidly fixing his body to prevent any possibility of movement, and avoiding most active physical tasks. This child becomes quite upset when movement is forced on him, especially if it is unexpected. In child's occupational performance area there is marked decrease due to dislike of activities of daily living such as walking over bumpy ground, climbing stairs, stepping over obstacles, leaning backward or riding in car is described as characteristics of gravitational insecurity (Lee, 1987). Children with gravitational insecurity may exhibit limited participation in gross motor play, avoidance or fear of escalators, elevators, cars, or planes, or resistance to being off the ground.

Theoretical Background for Gravitational Insecurity

Gravitational insecurity has been hypothesized to be due to poor modulation of otolithic input (Fisher and Bundy, 1989). It's a distinct disorder that may occur in individuals with normal postural ocular responses. Ayres (1979), Fisher & Bundy (1989) conceptualized that GI is characterized by decreased vestibulocerebellar functioning (primarily difficulty in processing information from the utricles and saccules of the vestibular system). This possibly decreases vestibularocular 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. The other factors contributing to gravitational insecurity is due to disorienting to perceptual experiences in children particularly to depth perception; lack of visual input during motor task; difficulty integrating visual, vestibular, and proprioceptive input (Bloomberg, Mulavara, & Cohen, 2001; Lee, 1987). Finally some evidences have also proved that increased sensitivity to the vestibular stimulation or visual – vestibular conflict can result in motion sickness (Baloh & Honrubia, 1979)

Need for the Study

Identification of gravitational insecurity has been based on a subjective process involving informal assessment and clinical observation of behaviors reflecting symptoms of the disorder. Lee (1987) conducted a domain specification study as the first step in the development of an attitude scale to identify children with gravitational insecurity. May-Benson (1988) developed an objective 15 item assessment of gravitational insecurity in children. In the planning phase of GI assessment development, Benson & Koomar constructed the operational definition and characteristics of Gravitational insecurity, based on a literature review (Ayers, 1979, Fisher & Bundy, 1989, and Lee, 1987), survey of a panel of master occupational therapist experienced in working with children having sensory integrative dysfunction. In item construction phase, Item format and scoring criteria were developed through literature review, feedback from expert in the field of occupational therapy, and clinical observation of children with suspected gravitational insecurity, resulting in 15 items and 3 behavioral categories (Avoidance behavior, Emotional response and Postural response). In quantitative evaluation phase, The pilot study was done by using Gravitational Insecurity (GI) assessment. The GI assessment was administered on eighteen children with GI and matched by age, gender typically developing children. A stepwise discriminant analysis indicated that four tasks (backward roll, jump off chair- eyes closed, supine on ball- active, and tilt board step) correctly discriminated gravitationally insecure children from typically developing children. These four items correctly classified 89% of gravitationally insecure children and 99% of typically developing children. The results indicated that the four tasks were sufficient to identify children with gravitational insecurity but additional five items (Jumping, height jump, stand on chair, forward roll and supine on ball passive) contributed to reduction of the false positives. A stepwise discriminant analysis on the sub scores of all three behavioral indicated that combined categories of emotional responses, and postural responses were able to discriminate between the groups and avoidance behavior did not contribute additional significant

discriminant. Finally, these results found that combined emotional and postural response sub scores correctly classified 83.3% of gravitationally insecure children and 100% of typically developing children. The assessment was revised to 9 items with 2 behaviour categories based on this initial study results. It requires 30-40 minutes for administration. Hence the current study was carried out to refine the GI assessment tool in order avert time consumption of GI assessment among Indian children. The purpose of this study, therefore, was to refine the Gravitational Insecurity assessment.

METHODOLOGY

The aim of this study was to refine Gravitational insecurity assessment revised version among the Indian population.

Sample

Convenience sampling procedure was done for the selection of samples. Group I included 200 children with Gravitational Insecurity issue. Group II included typically developing, matched by age and gender with Group I. Gravitational insecurity children were recruited from different special schools and therapy centers in Chennai. Typically developing children were recruited from a mainstream school in Chennai.

Screening Criteria

A. Inclusion Criteria

(i) Group I children were identified by therapists of the selected special school and therapy centre based on their behaviour during the intervention sessions mainly demonstrating fearful response in any two of the following category:

- Movement on an unstable surface
 - Unexpected of quick movement by another person
 - Change of head position
 - Change of head position with feet moved off a stable surface.
 - Static position or movement on a high surface
 - Disorienting to lack of visual input
- Additionally the child met the following criteria,

- Age group of 5- 10 yrs
 - Both genders
 - Good comprehension skill required
 - Normal (or) corrected hearing
 - Normal (or) corrected vision
 - Past or present history of OT intervention
- (ii) Group II children were matched according to the age and gender of group I children
- No behavioral characteristic of GI
 - No educational remediation
 - Age group of 5 -10 yrs
 - Both genders
 - Good comprehension skill required
 - Normal or corrected hearing
 - Normal or corrected vision
 - No past or present history of any OT intervention

B. Exclusion Criteria common for both the groups

- Children with physical handicap
- Children with comprehension problem

Gravitational Insecurity Assessment (Revised Version)

GI assessment was developed by May-Benson in 1988. The original version consist of 15 items. The revised version consists of 9 items. It is an individually administering test. The administration time is about 10 minutes. Inter rater reliability is 0.959 (ICC). Equipment required for GI assessment: GI assessment manual, Scoring sheets, Pencil, Floor mat, Meter / yard stick, Standard therapy ball, Standard adult chair, Tilt board, Masking tape. 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

Procedure

Experienced pediatric occupational therapists in Chennai, India were contacted, oriented to the nature of study, and requested to identify possible children with gravitational insecurity. The purpose of the study was then explained to the appropriate authorities of the special schools and therapy centers involved and informed consent form was obtained from parents. Testing was conducted at therapy centers or special schools in Chennai, India.

Typically developing children, selected from mainstream schools in Chennai, were matched by age and gender. Informed consent was obtained and testing was conducted at the school in the same manner as with gravitational insecurity children. The evaluation was conducted in the standardized format according to the protocol developed for the GI Assessment by May-Benson. All subjects were oriented to the tasks. The directions were given in English language for each task and children were requested to complete the tasks two times. The primary investigator administered the GI assessment to the two hundred (n=200) Gravitational Insecurity children and matched gender and age typically developing children to determine the discriminant ability of the GI assessment.

Data Analysis & Results

SPSS 18 version was used to analyse the data. Discriminant analysis and stepwise discriminant analysis was used to identify which behavioral response category and which test items were able to discriminate children with gravitational insecurity from typically developing children.

RESULTS & DISCUSSION

Gravitational Insecurity is a common sensory modulation disorder which directly hampers the performance area of the child in play and other daily living activities. Occupational therapists use a Sensory Integrative Frame of Reference when addressing a child's development of functional skills from a sensory standpoint (Kimball, 1999). Using Sensory Integrative principles, the therapist incorporates meaningful activities that provide specific sensory stimuli to elicit an adaptive response, thereby assisting the child in his or her overall motor and conceptual learning (Fisher & Murray, 1991). The therapist analyzes the child's processing of vestibular, proprioceptive and tactile sensations in relation to his or her ability to learn and move which are essential components of the child's daily life. It is important to realize how movement affects the child and that the problem has a neurological basis. Sensory integration theory postulates that difficulties with processing

sensory information can impede a child's acquisition of concept and motor learning. Children who are gravitationally insecure need a lot of support and encouragement from the therapist i.e., they must trust us implicitly and we must earn that trust. The general guidelines while treating children with gravitational insecurity: Child must be in control of the amount and type of movement that occurs during an activity; Clients seem to be especially fearful for movement in backward space i.e., they are fearful when they move backward because they cannot see where they are going (Fisher, 1988). The focused activities that which can be given for the child climbing steps, step over things like obstacle games, practice sitting on unstable surfaces. Movement activities can include: swings, hammock, scooter board, slide, see saw, bikes, barrel, rolling down a slope, rolling up in a rug, climbing play equipment, trampoline, rocking horse, rocking chair, sit and spin toys etc. For example, sit in a hammock with feet

on the floor, lie in a barrel, lie on a scooter board with hands / feet on the ground, sitting in a box on a scooter board, climbing over cushions on the floor, lie on a swing with feet on the floor. Deep proprioceptive activities can include, firm holding at the hips or shoulders, or adding wrist / ankle weights or a backpack with bean bags for the child to carry. Discriminant analysis was done to assess the power of discrimination of the GI assessment. The results of the behavioral category indicated that emotional response and postural response were discriminated correctly among the two groups. Further, step wise discriminant analysis shows that 96.4% of GI children were correctly classified among the Emotional Response and 100% of GI children were correctly classified among the Postural Response from the typically developing children. Review of the individual subject classification revealed that the one subject was misclassified using the total score of emotional response.

Table 1
Final form of Gravitational Insecurity assessment

SI No	Items	Description of Items
1	Height Jump	Participant jumps over a stick raised to 10 cms (4") off ground
2	Jump off Chair (EC)	Participant hops off chair with eyes closed (EC)
3	Forward Roll	Participant does a forward somersault.
4	Tilt Board Step	Participant steps on tilt board, then steps off backward.
5	Supine on Ball - Active	Participant lies back on ball, then stands up

Similar procedures were done to identify which test item best discriminate between the two groups. The results revealed that all the nine items were discriminated statistically at 100% level. Stepwise discriminant analysis concluded that the 5 items (height jump, jumping with eye closed, forward roll, tilt board step and supine on ball - active) have a more discriminating variability based on high eigenvalues (19.26) when compared with the eigenvalues (14.79) of the other 4 items (jumping, stand on chair, backward roll, supine on ball – passive) of the GI assessment. Finally, classification analysis revealed that five tasks were sufficient to identify Gravitational Insecurity in children.

CONCLUSION

This study has been done to refine Gravitational Insecurity assessment. The results concluded that 5 items of gravitational insecurity assessment has good discriminative power and Gravitational Insecurity assessment was revised from 9 items to 5 items. This revised version of GI assessment is a less time consuming and it can be used as an assessment tool as well as outcome measure for intervention. Future studies are needed to establish the reliability and validity of the revised version before it may be routinely used.

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REFERENCES

1. Ayres, A. J. (1963) Eleanor Clarke Slagle Lecture – The development of perceptual - motor abilities: A theoretical basis for treatment of dysfunction. *AJOT*, 27, 221-225.
2. Ayres, A. J. (1965) Pattern of perceptual – motor dysfunction in children: A factor analytic study. *Perceptual and Motor Skills*, 20, 335–368.
3. Ayres, A.J. (1972a) Sensory integration and learning disorder. Los Angeles: *Western Psychological Services*.
4. Ayres, A.J. (1972b) Southern California Sensory Integration Tests. Los Angeles: *Western Psychological Services*.
5. Baloh, R. W et.al (1979). Clinical neurophysiology of the vestibular system. Philadelphia: F. A Davis
6. Bloomberg, J. et al (2001) Developing sensorimotor countermeasures to mitigate postflight locomotor dysfunction. *American Institute of Aeronautics and Astronautics*, Cape Canaveral, FL.
7. Bundy, A.C. et.al (2002) Sensory Integration: *Theory and Practice* (2nd ed). Philadelphia: F. A. Davis.
8. Bundy, A. et.al (2007) How sensory processing affect play? *AJOT*, 61, 201-206.
9. DeGangi, G.A. (2000) Paediatric disorders of regulation in affect and behaviour: A therapist guide to assessment and treatment. SanDiego, CA: *Academic Press*
10. Dunn, W. (1997) the impact of sensory processing abilities on the daily lives of young children and families: A conceptual model. *Infants and young*, 9, 23-25.
11. Dunn, W (1999). The sensory profile: User's manual. San Antonio, TX. *Psychological Corporation*.
12. Dunn, W. (2001). Eleanor Clarke Slagle Lecture – The sensation of everyday life: Empirical, theoretical and pragmatic considerations. *AJOT*, 55, 608-620.
13. Fisher, A. G (1988). The validity of the clinical diagnosis of vestibular dysfunction. *Occupational Therapy Journal of Research*, 3 – 20.
14. Fisher, A. et al (1989). Vestibular stimulation in the treatment of postural and related disorders. *Manual of physical therapy techniques* (239-258.).
15. Hall, L. et.al (2007) the effect of sound based intervention on children with sensory processing disorder and visual – motor delay. *AJOT*, 61, 209 – 214.
16. Kavar, M. (2005) A sensory integration context for vision. Functional visual behaviour in children: *An occupational therapy guide to evaluation and treatment option* (2nd ed, pp 87-144).
17. Kientz, M. et al (1997) A comparison of children with autism and typical developing on the sensory profile. *AJOT*, 51, 530-537.
18. Knickerbocker, B.M (1980) A holistic approach to learning disability. Thorofare, J: Slack
19. Koomar. J (1995) Vestibular dysfunction is associated with anxiety rather than behavioral inhibition or shyness. *Unpublished doctoral dissertation*.
20. Lane, S.J. et.al (2000). Towards a consensus in terminology in sensory integration theory and practice: Part 2: Sensory integration pattern of function and dysfunction. *Sensory Integration Special Interest Section Quarterly*, 23, 1-3.
21. Lee, L (1987) Domain specification of gravitational insecurity for school aged children. *Unpublished masters' thesis*.
22. Levinson, H (1989a) The cerebellar-vestibular predisposition to anxiety disorders. *Perceptual and Motor Skills*, 68, 323-338.
23. Levinson, H (1989b) A cerebellar-vestibular explanation for fear/phobia:

- Hypothesis and study. *Perceptual and Motor Skills*, 68, 67-84.
24. May – Benson, T. A (2007). *Identifying gravitational insecurity in children with sensory integrative dysfunction: A pilot study*. *AJOT*, 61, 142 – 148.
 25. McIntosh, D. N. et.al (1999.) Sensory – modulation disruption, electrodermal responses, and functional behaviors: *Developmental Medicine and Child Neurology*, 41, 608 – 615.
 26. Miller, L.J. et.al (2000) Towards a consensus in terminology in sensory integration theory and practice; Part 1: Taxonomy of neurophysiological process. *Sensory Integration Special Interest Section Quarterly*, 23, 1 – 4.
 27. Miller, L. J (2001) Towards a consensus in terminology in SI theory & practice: Part 2: SI pattern of function and dysfunction. *SI special interest section Quarterly*, 28, 10-15
 28. Miller, L.J. et.al (2004) Position statement on terminology related to sensory integration dysfunction. *S.I. Focus*, pp. 6 – 8.
 29. Miller, L.J. et.al (2007) Lessons Learned: A pilot study on occupational therapy effectiveness for children with sensory modulation disorder. *AJOT*, 61, 161–166.
 30. Miller, L.J (2006) Sensational kids: help and hope for children with sensory processing disorder. New York: Putnam.
 31. Mulligan, S. (1998) Pattern of sensory integration dysfunction: A confirmatory factor analysis. *AJOT*, 52, 819 – 828.
 32. Parham, D.L & Mailloux (1995) Sensory Integration & Occupational. In A.C. Bundy, S. J. Lane, & E. A. Murray (Eds) *Sensory Integration: Theory & Practice*, 413-432. Philadelphia: F. A. Davis
 33. Parham, L.D (2002) Sensory integration and occupation. In A. C. Bundy, S.J Lane, & E.A. Murray, *Sensory integration: Theory and Practice (2nd ed, pp 413 – 434)*
 34. Shaffer, M (1979) Primal terror: A perspective of vestibular dysfunction. *Journal of Learning Disabilities*, 12, 30-33.
 35. Steinberg, M et.al (1977) Vestibular dysfunction in young children with minor neurological impairment. *Developmental Medicine and Child Neurology*, 18, 639-651.
 36. Tomchek, D.S. et.al (2007) Sensory processing in children with and without autism: A comparative study using the short sensory profile. *AJOT*, 61, 190-198.
 37. Weisberg, A (1984) The role of psychophysiology in defining gravitational insecurity: A pilot study. *Sensory Integration Special Interest Section Newsletter*, 7, 1-4.
 38. Wilbarger, P (1988). Sensory Defensiveness. *Presented at Annual Interdisciplinary Doctoral Conference*, Boston University, Boston.