

Neuromotor Examinations for Infants and Young Children less than Five Years Old

— sensory fibres
— motor fibres

Optic (II)
sensory: eye



Trochlear (IV)
motor: superior oblique muscle

Abducent (VI)
motor: external rectus muscle



Trigeminal (V)
sensory: face, sinuses, teeth, etc.
motor: muscles of mastication

Oculomotor (III)
motor: all eye muscles except those supplied by IV and VI



Olfactory (I)
sensory: nose



Facial (VII)
motor: muscles of the face



Hypoglossal (XII)
motor: muscles of the tongue



Intermediate motor: submaxillary and sublingual gland

sensory: anterior part of tongue and soft palate

intermediate nerve

Vestibulocochlear (VIII)
sensory: inner ear

vestibular cochlear



Glossopharyngeal (IX)
motor: pharyngeal musculature

sensory: posterior part of tongue, tonsil, pharynx



Vagus (X)
motor: heart, lungs, bronchi, gastrointestinal tract

sensory: heart, lungs, bronchi, trachea, larynx, pharynx, gastrointestinal tract, external ear



Accessory (XI)
motor: sternocleidomastoid and trapezius muscles



Administration

“ Physical therapists, occupational therapists, physicians, pediatric nurses, and other health care providers who have had appropriate training can administer the HINT.”

Assessments of Neuromotor Functioning

- Infant Motor Profile (IMP)
- Harrison Infant Neuromotor Test (HINT)
- Alberta Infant Motor Scale (AIMS)
- Hammersmith Infant Neurological Examination (HINE)
- Bayley Scales of Infant Development II (BSID)
- Peabody Developmental Motor Scales (PDMS)

Infant Motor Profile (IMP)

Test

- Video-based assessment
- For infants aged 3 to 18 months (may be used for children older than 18 months with a moderate/severe development motor disorder)
- Consists of 80 items
- Organized into 5 subtests
 - Variability (size of repertoire)
 - Variability (ability to select)
 - Symmetry
 - Fluency
 - Performance

Case Study

- 80 infants (40 full term, 40 premature)
- Assessed at 4, 6, 10, 12, and 18 months.
- Administered the IMP and the AIMS
- Objective: to test reliability and congruent validity of the IMP and AIMS
- Results: high correlation between IMP and AIMS scores.
 - Implies both are reliable to test a child's motor behavior
- AIMS scores increased with age
 - Suggests a strong correlation between age and AIM test performance.
- IMP Results: pre-term infants scored much lower than full term infants

Harris Infant Neuromotor Test (HINT)



Test

- Assesses for possible motor and/or cognitive development disorders
- Used for infants 2.5 – 12.5 months of age
- Four general areas:
 - 1.) General background information
 - 2.) caregiver's concerns
 - 3.) 21- item testing section
 - 4.) overall clinician impression
- 15 to 30 minutes to administer and score

Case Study

- 67 US infants (ranging from 2.5 – 12.5 months of age)
- 64 Canadian infants
- Compared US infants to Canadian infants to test validity of the HINT
- Results: no difference in scores between those of US infants and Canadian infants
 - Canadian norms can be applied to US infants
- Compared HINT scores to the Ages and Stages Questionnaire
- Results: parents' responses on the ASQ are slower than results from the HINT

(McCoy, S. W., et al., 2009)

Harris Infant Neuromotor Test (HINT)



Harris Infant Neuromotor Test (HINT) Items

Test Method	Cognitive or Behavioral Development Items	Motor Development Items
<p>Observation (infant is observed when placed in or allowed to move independently into supine, prone, sitting, and standing positions)</p>	<ul style="list-style-type: none"> ● Behavior and cooperation ● Presence of stereotypical behaviors 	<ul style="list-style-type: none"> ● Mobility, supine ● Neck retraction, supine ● Eye muscle control ● Head position, prone ● Upper-extremity position, prone ● Head position, sitting ● Trunk position, sitting ● Locomotion and transition skills ● Posture of hands ● Posture of feet ● Frequency and variety of movements
<p>Testing (infant is provided stimulation or is handled by the examiner to determine scores)</p>	<ul style="list-style-type: none"> ● Head circumference 	<ul style="list-style-type: none"> ● Visual following ● Asymmetrical tonic neck reflex ● Reaching from supine position ● Passive range of motion in supine position ● Head righting in transition from supine to prone to supine positions ● Trunk mobility in transition from supine to prone to supine positions ● Passive range of motion in prone position

Alberta Infant Motor Scale (AIMS)

Test

- Infant developmental test
- Used to test motor performance from birth-walking
- 58 items in 4 positions (supine, prone, sitting, and standing) are administered
- Each of the 58 items have 3 movement components:
 - Weight-bearing
 - Postural ailments
 - Antigravity movement

Case Study

- 100 Dutch infants
- Children were observed individually for 20-30 minutes
- Scores were compared to a Canadian reference group
- Dutch infants scored lower as compared to the Canadian reference group
 - Canadian norm values not relevant to Dutch population
- Further studies needed to achieve new norms for the AIMS

Hammersmith Infant Neurological

Test

Termination (

Case Study

- For infants 2 to 24 months
- Developed by Dubowitz et al.
- 3 sections:
 - 1) Neurological Exam – postures, cranial nerve function, reflexes, tone, movements
 - 2) Development of Motor Function – head control, sitting, walking, crawling, rolling, grasping
 - 3) State of Behavior – consciousness, social orientation, emotional state
- 70 infants with CP
- Evaluated at 3, 6, 9, 12 months
- Findings:
 - Progressive motor development until about 9 months
 - Similar scoring between infants with diplegia and quadriplegia
 - Scores consistent with GMFCS (test of gross motor skills) at 2 years

Hammersmith Infant Neurological Examination (HINE)

Table 3 – Items of Hammersmith Infant Neurological Examination in the total population

	Cranial nerve	Posture	Movements	Tone	Reflexes
	Median (range)	Median (range)	Median (range)	Median (range)	Median (range)
3 months					
Diplegia	11 (7–15) ^{ns}	10 (5–14) ^a	1 (0–2) ^{ns}	12.5 (6–18) ^a	3 (1–7) ^{ns}
Quadriplegia	10 (7–13) ^c	9 (3–11) ^c	0 (0–1) ^c	9 (3–13) ^c	2.5 (1–5) ^c
Hemiplegia	13 (11–15) ^b	14 (11–16) ^b	4 (2–5) ^b	16 (13–22) ^b	7 (4–9) ^b
6 months					
Diplegia	12 (8–15) ^{ns}	11 (8–16) ^a	1 (0–2) ^{ns}	13 (7–20) ^a	4 (1–7) ^{ns}
Quadriplegia	11 (7–14) ^c	9 (4.5–12) ^c	0 (0–1) ^c	9.5 (3.5–15) ^c	3 (1–5) ^c
Hemiplegia	14 (12–15) ^b	14 (12–16) ^b	4 (2–5) ^b	18 (13–22) ^b	7 (4–9) ^b
9 months					
Diplegia	13.5 (9–15) ^{ns}	12.5 (9–16) ^a	1 (0–3) ^{ns}	14 (10–21) ^a	4 (2–8) ^{ns}
Quadriplegia	12.5 (9–15) ^c	10 (6–12) ^c	1 (0–2) ^c	11 (6–15) ^c	3.5 (1–6) ^c
Hemiplegia	15 (13–15) ^b	15 (13–17) ^b	4 (2–5) ^b	20 (14–23) ^b	8 (4–10) ^b
12 months					
Diplegia	13.5 (10–15) ^{ns}	13 (9–18) ^a	1 (0–3) ^{ns}	14.5 (10–22) ^a	5 (2–9) ^{ns}
Quadriplegia	12.5 (9–15) ^c	10 (6–13) ^c	1 (0–2) ^c	12 (7–16) ^c	4 (1–6) ^c
Hemiplegia	15 (13–15) ^b	16 (15–18) ^b	4 (3–5) ^b	21 (17–23) ^b	8 (5–11) ^b

ns = no statistical significance on difference between diplegia and quadriplegia.

^a Diplegia vs quadriplegia ($p < 0.001$).

^b Diplegia vs hemiplegia ($p < 0.001$).

^c Quadriplegia vs hemiplegia ($p < 0.0001$).

(Rameo et al., 2007)

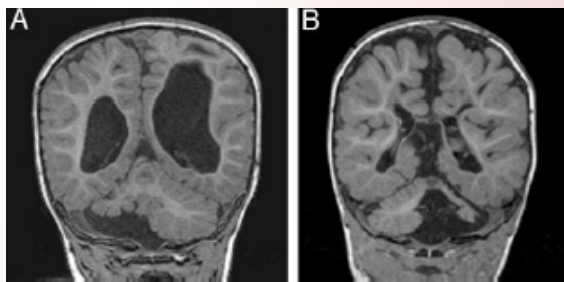
Bayley Scales of Infant Development II (BSID)

Test

- For infants 1 to 42 months
- 45 to 60 minutes to administer
- Measures development of 3 components:
 - Cognitive
 - Motor
 - Behavioral

Case Study

- 1,730 extremely low birth weight infants between 18 and 30 months tested
- Test stability of neuromotor and functional results for infants
- Results: Most were stable between 18 and 30 months
 - Normal tone predicts normal neuromotor exam
 - Abnormal tone may not



Test

- Birth to 5 years
- Evaluates emerging or present gross and fine motor abilities
- 3 composite standard scores
 - 1.) Gross Motor Quotient
 - 2.) Fine Motor Quotient
 - 3.) Total Quotient
- 25 to 30 minutes to administer at 1 year

Peabody Developmental Motor Scales-2 (PDMS)

Case Study

- 100 premature infants
- Compared 3 assessments that predict motor outcome at 12 months
- PDMS-2 and AIMS results coincided
 - Predicted by time on ventilation and intraventricular hemorrhage (IVH)
- Poor functional outcomes may be due to motor difficulties

Summary

- Currently, very few neuromotor assessments available for children under age 5
- Generally administered by PT, OT, Pediatric Nurses, Physicians, etc.
- Further research is needed

References

- Fleuren, K. M. W., Smit, L. S., Stijnen, T. & Hartman, A. (2007). New reference values for the Alberta Infant Motor Scale need to be established. *Acta Paediatrica*. 96: 424-427.
- Heineman, K. R., Bos, A. F., & Hadders-Algra, M. (2008). The infant motor profile: a standardized and qualitative method to assess motor behavior in infancy. *Developmental Medicine and Child Neurology*. 50(4): 275-282.
- McCoy, S. W., et al. (2009). Harris Infant Neuromotor Test: comparison of US and Canadian normative data and examination of concurrent validity with the ages and stages questionnaire. *Physical Therapy*. 89(2): 173-179.
- Peralta-Carcelen M. et al. (2009). Stability of neuromotor outcomes at 18 and 30 months of age after extremely low birth weight status. *Pediatrics*. 123(5):887-895.
- Romeo, D. M. M. et al. (2008). Neuromotor development in infants with cerebral palsy investigated by the Hammersmith Infant Neurological Examination during the first year of age. *European Journal of Paediatric Neurology*. 12: 24-31.
- Snider, L. et al. (2009). Prediction of motor and functional outcomes in infants born preterm assessed at term. *Pediatric Physical Therapy*. 21(1): 2-11.