

# Hammersmith Infant Neurological Examination (HINE)



**Holland Bloorview**  
Kids Rehabilitation Hospital





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# Webinar Objectives:


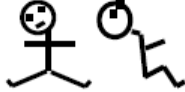
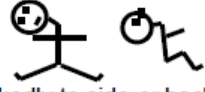



1. Provide an introduction to administering the Hammersmith Infant Neurologic Examination (HINE)
2. Provide an introduction to scoring the HINE



# Hammersmith Infant Neurological Exam (HINE)

- ▶ For infants between 3-24 months of age (corrected)
- ▶ 26 items – cranial nerves, posture, quality/quantity of mvt, tone, reflexes

## ASSESSMENT OF POSTURE (note any asymmetries)

	score 3	score 2	score 1	score 0	sc	Asymmetry / comments
Head in sitting	 Straight; in midline		 Slightly to side or backward or forward	 Markedly to side or backward or forward		
Trunk in sitting	 Straight		 Slightly curved or bent to side	 Very rounded    rocketing back    bent sideway		

# Hammersmith – Why it is GREAT!

- ▶ Easy to perform, scoreable, fast to administer, standardized infant neuro exam
- ▶ Accessible to all clinicians
- ▶ It will improve your neurological exam skills!
- ▶ Excellent inter-observer reliability -(even in less experienced staff)
- ▶ HINE optimality score provides prognostic information on motor outcomes
- ▶ Asymmetry scores - very sensitive for picking up Hemiplegia
- ▶ Sensitivity and specificity is high (>90%)
- ▶ Inexpensive - scoring sheets freely available
- ▶ Follow infant with sequential exams

# When administering the HINE...

- Place infant in an age appropriate safe position i.e. floor
- Have infant in appropriate clothing so that all body parts can be seen
- Parents can assist
- Can proceed even if infant is crying
- Do not need to administer items in sequence as per proforma
- Look for age and gross motor appropriate response(s)
- Provide support as needed for young infants and infants who are more physically challenged

# Items you will need...

- ▶ Reflex hammer
- ▶ High contrast toy, black and white object works best
- ▶ Simple rattle
- ▶ Measuring tape
- ▶ Score sheet/ proforma (<https://www.mackeith.co.uk/hammersmith-neurological-examinations/hammersmith-neurological-examinations-subscriber-content/recording-and-scoring-proformas/>)





# Assessment of Cranial Nerve Function

	score 3	2	score 1	score 0
<b>Facial appearance</b> (at rest and when crying or stimulated)	Smiles or reacts to stimuli by closing eyes and grimacing		Closes eyes but not tightly, poor facial expression	Expressionless, does not react to stimuli
<b>Eye movements</b>	Normal conjugate eye movements		<b>Intermittent</b> Deviation of eyes or abnormal movements	<b>Continuous</b> Deviation of eyes or abnormal movements
<b>Visual response</b> Test ability to follow a black/white target	Follows the target in a complete arc		Follows target in an incomplete or asymmetrical arc	Does not follow the target
<b>Auditory response</b> Test the response to a rattle	Reacts to stimuli from both sides		Doubtful reaction to stimuli or asymmetry of response	No response
<b>Sucking/swallowing</b> Watch infant suck on breast or bottle. If older, ask about feeding, assoc. cough, excessive dribbling	Good suck and swallowing		Poor suck and/or swallow	No sucking reflex, no swallowing

**Facial Appearance:** observe face watch for asymmetry with smile or grimace (no talking)


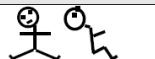
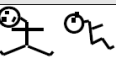






**Eye Movements:** observe eye movements with eye tracking

**Visual Response:** using a **high contrast toy**, Start at midline find the focal point then move toy slowly in a circular arc. Allow several attempts to follow, ensure **no noise** is involved

**Auditory Response:** clap hands or shake a rattle on either side of child but do not use harsh or sharp sounds, **ensure no visual contact with toy**

**Sucking/Swallowing:** by parent report or observe use of soother

# Assessment of Posture

	score 3	score 2	score 1	score 0
<b>Head</b> in sitting	 Straight; in midline		 Slightly to side or backward or forward	 Markedly to side or backward or forward
<b>Trunk</b> in sitting	 Straight		 Slightly curved or bent to side	 Very rounded      rocketing back      bent sideways
<b>Arms</b> at rest	In a neutral position, central straight or slightly bent		<b>Slight</b> internal rotation or external rotation  <b>Intermittent</b> dystonic posture	<b>Marked</b> internal rotation or external rotation or  dystonic posture hemiplegic posture
<b>Hands</b>	Hands open		<b>Intermittent</b> adducted thumb or fisting	<b>Persistent</b> adducted thumb or fisting
<b>Legs</b> in sitting	Able to sit with a straight back and legs straight or slightly bent (long sitting) 		Sit with straight back but knees bent at 15-20 ° 	Unable to sit straight unless knees markedly bent (no long sitting) 
in supine and in standing	Legs in neutral position straight or slightly bent	<b>Slight</b> internal rotation or external rotation	Internal rotation or external rotation at the hips	<b>Marked</b> internal rotation or external rotation or fixed extension or flexion or contractures at hips and knees
<b>Feet</b> in supine and in standing	Central in neutral position  Toes straight midway between flexion and extension		<b>Slight</b> internal rotation or external rotation  <b>Intermittent</b> Tendency to stand on tiptoes or toes up or curling under	<b>Marked</b> internal rotation or external rotation at the ankle  <b>Persistent</b> Tendency to stand on tiptoes or toes up or curling under

- For posture items: a “static” event therefore appropriate support is required to achieve an accurate assessment of posture
- Caregiver can provide external support as needed (i.e., age appropriate or physically challenged)
- True asymmetry vs asymmetry due to increased effort
- Look at posture in multiple positions (i.e., sitting, supine, supported standing)

# Assessment of Posture

**Head:** Observe position of head in sitting (provide as much support to trunk as needed)

- For 3-4 month old infants, provide support at the hips in sitting


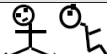
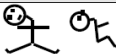


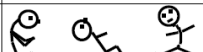



**Trunk:** Observe posture of trunk in sit (with or without support)

**Arms:** Observe position of arms in a relaxed position (supine or supported sit if needed)

**Hands:** Observe posture of hands in a supported position (throughout the assessment)

**Legs:** Observe the posture of the legs in sit, supine and stand (support as needed)

**Feet:** Observe the posture of the feet in supine and in standing (support as needed); observe if the dorsum of the foot is in line with the tibia

	score 3	score 2	score 1	score 0
<b>Head</b> in sitting	 Straight; in midline		 Slightly to side or backward or forward	 Markedly to side or backward or forward
<b>Trunk</b> in sitting	 Straight		 Slightly curved or bent to side	 Very rounded rocketing back bent sideways
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# Assessment of Movements

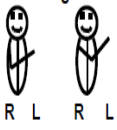

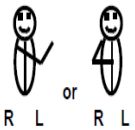
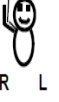
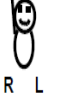

	Score 3	Score 2	Score 1	Score 0
<b>Quantity</b> Watch infant lying in supine	Normal		Excessive or sluggish	Minimal or none
<b>Quality</b> Observe infant's spontaneous voluntary motor activity during the course of the assessment	Free, alternating, and smooth		Jerky  Slight tremor	<ul style="list-style-type: none"> <li>• Cramped &amp; synchronous</li> <li>• Extensor spasms</li> <li>• Athetoid</li> <li>• Ataxic</li> <li>• Very tremulous</li> <li>• Myoclonic spasm</li> <li>• Dystonic movement</li> </ul>

**Quantity:** Place child in supine (may be age dependent). This is your overall impression of the amount (quantity) of independent movement

**Quality:** Throughout the assessment, this is your overall impression of the quality of the child's independent, spontaneous movements

# Assessment of Tone

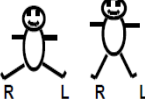
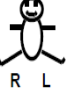




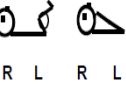

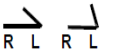

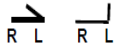

**Scarf Sign:** With one hand, **stabilize trunk at pelvis** and with the other hand take the child's arm across the chest. **Ensure NO trunk rotation**. With the child in a stable position, look at the trunk as a block, note the position of the elbow to midline.

	Score 3	Score 2	Score 1	Score 0
<b>Scarf sign</b> Take the infant's hand and pull the arm across the chest until there is resistance. Note the position of the elbow in relation to the midline.	Range:  R L R L		 R L	 R L or R L
<b>Passive shoulder elevation</b> Lift arm up alongside infant's head. Note resistance at shoulder and elbow.	Resistance overcomeable  R L	Resistance difficult to overcome R L	No resistance  R L	Resistance, not overcomeable  R L
<b>Pronation/supination</b> Steady the upper arm while pronating and supinating forearm, note resistance	Full pronation and supination, no resistance		Resistance to full pronation / supination overcomeable	Full pronation and supination not possible, marked resistance

**Passive Shoulder Elevation:** **With child in a stable position**, grasp forearm, lift arm forward and up above head to bring elbow in line with the ear. May also slightly abduct and externally rotate shoulder to elevate. Do one arm at a time, then together to compare. **Watch for resistance above 90 degrees.**

**Pronation/Supination:** **Straighten the arm, support the arm with one hand just above the elbow** while supinating and pronating the forearm. Ensure the elbow is maintained in extension. Look for resistance at head of ulna and radius.

# Assessment of Tone




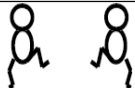
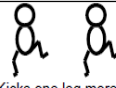
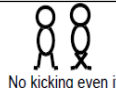




<b>Hip adductors</b> With both the infant's legs extended, abduct them as far as possible. The angle formed by the legs is noted.	Range: 150-80°  R L R L	150-160°  R L	>170°  R L	<80°  R L
<b>Popliteal angle</b> Keeping the infant's bottom on the bed, flex both hips onto the abdomen, then extend the knees until there is resistance. Note the angle between upper and lower leg.	Range: 150°-100°  R L R L	150-160°  R L	~90° or > 170°  R L R L	<80°  R L
<b>Ankle dorsiflexion</b> With knee extended, dorsiflex the ankle. Note the angle between foot and leg.	Range: 30°-85°  R L R L	20-30°  R L	<20° or 90°  R L R L	> 90°  R L

**Hip Adductors:** Best position is supine as **both hips and knees must be in extension**. Hold the legs at the ankles and abduct the legs gently, quickly and smoothly.

**Popliteal Angle:** Best position is in supine. **Flex knees and bring thighs up onto chest**. With hands around knees and thumbs on calves, straighten the knees and hold.

**Ankle Dorsiflexion:** **With knee in extension, place your flat hand on plantar surface of foot** push into dorsiflexion. Note the R1 angle.

# Reflexes and Reactions



	Score 3	Score 2	Score 1	Score 0
<b>Arm protection</b> Pull the infant by one arm from the supine position (steady the contralateral hip) and note the reaction of arm on opposite side.	 Arm & hand extend R L		 Arm semi-flexed R L	 Arm fully flexed R L
<b>Vertical suspension</b> hold infant under axilla making sure legs do not touch any surface – you may “tickle” feet to stimulate kicking.	 Kicks symmetrically		 Kicks one leg more or poor kicking	 No kicking even if stimulated or scissoring
<b>Lateral tilting</b> (describe side up). Hold infant up vertically near to hips and tilt sideways towards the horizontal. Note response of trunk, spine, limbs and head.	 R L	 L R	 R L	 R L

**Arm Protection:** With one hand supporting the trunk over the pelvis (**centre of diaper area**), with the other hand bring child to sit by rotating up through the side. **Note the reaction of the arm on the weight bearing side.**

**Vertical Suspension:** Hold the child with your hands under the axilla. Suspend the child upright with **no foot contact on any surface**. Someone may “tickle” feet to stimulate leg movement.

**Lateral Tilting :** Hold child vertically with support around the hips. Move quickly sideways towards horizontal. Avoid head going lower than hips. **Observe the response of upward side of the head, neck, trunk and limbs.**

# Reflexes and Reactions

<b>Forward parachute</b> Hold infant up vertically and quickly tilt forwards. Note reaction /symmetry of arm responses,	 (after 6 months)		 (after 6 months)	
<b>Tendon Reflexes</b> Have child relaxed, sitting or lying – use small hammer	Easily elicitable biceps knee ankle	Mildly brisk bicep knee ankle	Brisk biceps knee ankle	Clonus or at biceps knee

**Forward Parachute:** In vertical suspension, move child forward quickly towards the ground. **Avoid contact of the feet on the surface.**

**Tendon Reflexes:** Using a reflex hammer, test the reflexes of the biceps (elbow), quadriceps (knee) and Tendo-achilles (ankle). Flex joint being tested, place your thumb over tendon and strike your thumb to test reaction of muscle tendon.



# Scoring

- ▶ Each item scored from 3 (optimal), 2, 1, or 0 and asymmetry
- ▶ Each section can be scored and all sections totalled
- ▶ Total score range from 0 to 78 (higher = better neurological performance)
- ▶ Many items are not age dependent but for infants under 6 months there are differences in tone and postural reactions
- ▶ Total optimality score was set at 10% with suboptimal score below the 10<sup>th</sup> percentile

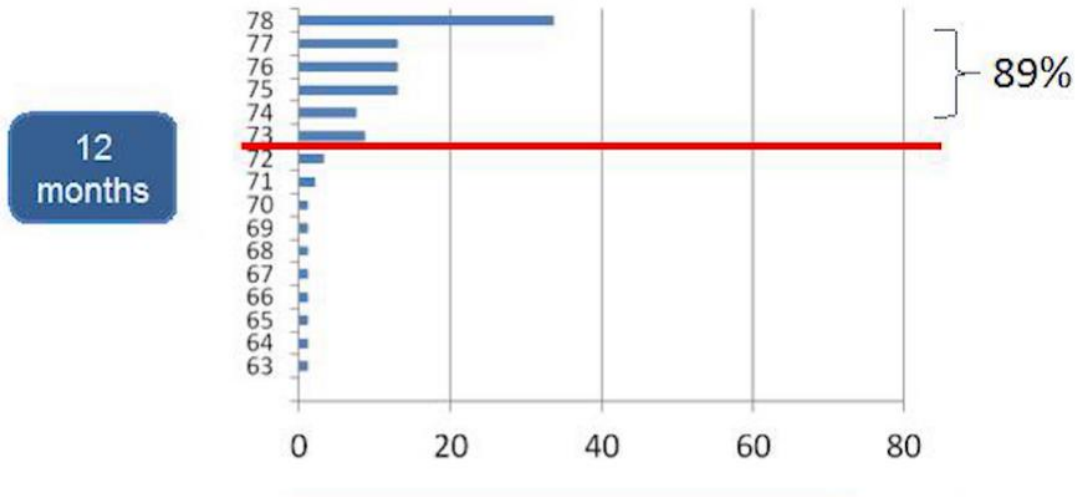
# Optimality Score

(now referred to as 10th percentile score)

The JOURNAL  
of PEDIATRICS

J Pediatr 1999;135:153-61.

Haataja L. et al. Optimality score for the neurologic examination of the infant at 12 and 18 months of age



Hammersmith Infant Neurological Examination (HINE) [Video].  
Retrieved from: <http://hammersmith-neuro-exam.com/videos/>

# Application of a scorable neurologic examination in healthy term infants aged 3 to 8 months

[Leena Haataja, MD](#) • [Frances Cowan, MD](#) • [Eugenio Mercuri, MD](#) • [Laura Bassi, MD](#) • [Andrea Guzzetta, MD](#)  
[Lilly Dubowitz, MD](#)

DOI: [https://doi.org/10.1067/S0022-3476\(03\)00393-7](https://doi.org/10.1067/S0022-3476(03)00393-7)

**Table. The range of global optimality scores and its median in different age groups**

	<b>Global score median (range)</b>
12 mo	73 (63-78)
28-32 wk	76 (72-78)
24-28 wk	73 (69-76.5)
20-24 wk	70 (61.5-74)
16-20 wk	67.5 (65.5-74)
12-16 wk	67 (62.5-69)

Median (and range) global scores in **very preterm ( $\leq 32$  weeks)**,  
**late-preterm (33-36 weeks)** and **term** born infants at different ages.

Age	3 months	6 months	9 months	12 months
Term infants	65.5 (62-69)	69 (64-74)	72.5 (65-78)	74 (65-78)
Late preterm infants	62 (57-69)	66 (60-72)	71 (63-75)	73 (64-77)
Very preterm infants	62 (51-67)	66 (52-71)	70 (57-76)	72 (60-77)

Hammersmith Infant Neurological Examination (HINE) [Video]. Retrieved from: <http://hammersmith-neuro-exam.com/videos/>

# HINE Scores that predict Cerebral Palsy

## Cut Off Scores for High Probability of CP

(sensitivity > 90%; specificity > 85%)

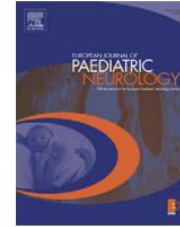
- ▶ 3 months < 56
- ▶ 6 months < 59
- ▶ 9 months < 62
- ▶ 12 months < 65

Romeo DM, et al. Neurological assessment in infants discharged from a neonatal intensive care unit. Eur J Paediatr Neurol. 2013 Mar;17(2):192-8. doi: 10.1016/j.ejpn.2012.09.006. PMID: 23062755.



ELSEVIER

Official Journal of the European Paediatric Neurology Society

**Original article****Neuromotor development in infants with cerebral palsy investigated by the Hammersmith Infant Neurological Examination during the first year of age**

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<sup>b</sup>Gait and Motion Analysis Laboratory, Department of Experimental & Clinical Pharmacology, University of Catania, Italy

<sup>c</sup>Department of Internal and Specialist Medicine, Section of Infectious Diseases, University of Catania, Italy

<sup>d</sup>Neonatal Intensive Care Unit, Department of Paediatrics, University of Catania, Italy

- ▶ At **3-6 months**, infants with quadriplegia, **GMFCS IV and V** and those with diplegia **GMFCS III** scored **below 40**, whereas diplegia **GMFCS I-II** and hemiplegia GMFCS I-II level mainly scored between **40-60**.
- ▶ 26% of infants with hemiplegia scored  $\geq 67$  at 12 months



# Hammersmith Infant Neurological Examination Clinical Use to Recommend Therapist Assessment of Functional Hand Asymmetries

Pietruszewski, Lindsay PT, DPT; Nelin, Mary Ann MD; Batterson, Nancy OT/L, SCFES, CLC; Less, Julia MPH; Moore-Clingenpeel, Melissa MA, MAS; Lewandowski, Dennis PhD; Levengood, Katelyn PT, DPT; Maitre, Nathalie L. MD, PhD

Author Information 

*Pediatric Physical Therapy* 33(4):p 200-206, October 2021. | DOI: 10.1097/PEP.0000000000000822

If  $\geq 4$  asymmetries on HINE, refer to early intervention for consideration of targeted motor-based therapies (Baby Constraint Induced Movement Therapy or Bimanual Therapy)

**Hammersmith Infant Neurological Examination (HINE): Score Interpretation Aid for Children Receiving Neonatal Follow-Up Care**

Clinical history: \_\_\_\_\_

Brain imaging (if available): \_\_\_\_\_

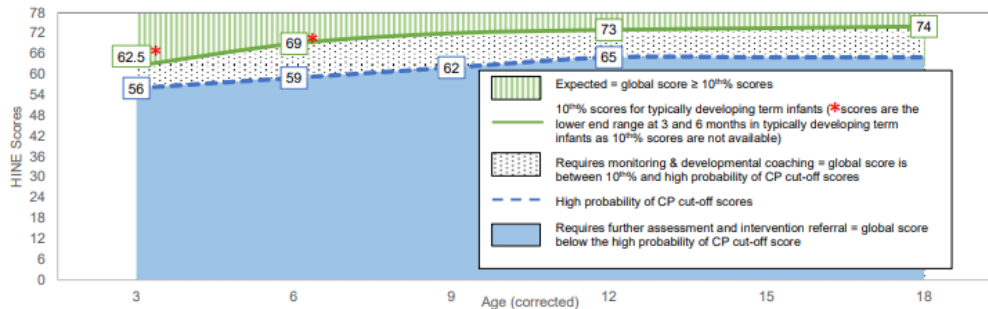
Visit	Child's Age (corrected)	Child's Global HINE Score	HINE Asymmetry Score	Corrected Age for GMA (if available)	GMA Category (if available)	Interpretation/Action	Discussed with family
1							<input type="checkbox"/>
2							<input type="checkbox"/>
3							<input type="checkbox"/>
4							<input type="checkbox"/>
5							<input type="checkbox"/>

**HINE Scoring Aid Reference Information:**

- Interpret HINE scores with clinical reasoning (e.g., term versus preterm, risk factors for CP, health co-morbidities, brain imaging, and General Movements Assessment (GMA)) when comparing to those from typically developing term infants. Follow the trajectory of HINE scores over time.
- The table provides expected global scores (median/ranges) for term<sup>1,2</sup> (column 2) and preterm infants<sup>3,4</sup> of various gestational ages (column 3,4) with typical 2-year development. 10<sup>th</sup> percentile scores (optimally scores) (equal to or above) which infants are considered to have typical neurological performance<sup>1,4</sup> are provided where available (column 2,4).
- Typically developing preterm infants have median global scores that range from 9 points at 3 months to 3.5 points at 12 months lower than typically developing term-born infants (Table column 3,4)<sup>3,4</sup>. There is also a wider range of scores around the median in preterms.
- CP cut-off scores (column 5) are global scores below which term and preterm infants with etiologic risk for CP (e.g., preterm, neonatal encephalopathy) have a high probability of developing CP<sup>5</sup>. Refer for early intervention.
- Infants with unilateral CP may not have low global scores but can have >5 asymmetries (often after 15 months of age) representing significant asymmetric neurologic performance<sup>6</sup>. Refer for early intervention if >5 asymmetries are present regardless of infant's age.

Column 1	Column 2 Global Scores for typically developing term born infants <sup>1,2</sup>	Column 3 Global scores for low-risk LPT and VPT infants <sup>3</sup>	Column 4 Global scores for low-risk EPT infants <sup>4</sup>	Column 5 Cut-Off scores for high probability of CP <sup>5</sup>
Child's Age (corrected)	37-42 weeks GA	mean GA 32 weeks (range 27-36)	mean GA 27 weeks (range 23-31)	All birth gestational ages but definitive data not available for EPT infants
	Median (range)	Median (range)	Median (range)	
3 months	67 (62.5-69) <sup>2</sup>	62 (51-69) <sup>3</sup>	58 (47-69) (10 <sup>th</sup> % 53) <sup>4</sup>	<56 (sen 96% sp 85%) <sup>5</sup>
6 months	73 (69-76.5) <sup>2</sup>	66 (52-72) <sup>3</sup>	67 (54-76) (10 <sup>th</sup> % 62) <sup>4</sup>	<59 (sen 90% sp 89%) <sup>5</sup>
9 months	N/A	70.5 (57-76) <sup>3</sup>	71.5 (62-78) (10 <sup>th</sup> % 67) <sup>4</sup>	<62 (sen 90% sp 91%) <sup>5</sup>
12 months	76 (63-78) (10 <sup>th</sup> % ≥73) <sup>1</sup>	72.5 (60-77) <sup>3</sup>	73.5 (67-78) (10 <sup>th</sup> % 70) <sup>4</sup>	<65 (sen 91% sp 90%) <sup>5</sup>
18 months	78 (71-78) (10 <sup>th</sup> % ≥74) <sup>1</sup>	N/A	N/A	N/A
	10 <sup>th</sup> percentile scores (10 <sup>th</sup> %): 90% of infants score at or above this level. * See legend in graph below.	Data for LPT and VPT infants are combined – medians are similar, but the range span is narrower for LPT than VPT	Note median scores are considerably lower for EPT infants than FT, LPT and VPT infants at 3 months.	A global score <40 at any age is highly predictive of CP GMFCS III-V at 2 years of age <sup>7</sup> .

N/A not available, Low-risk=no additional CP etiologic risk aside from being preterm<sup>3,4</sup>, LPT Late preterm 33-36 weeks gestational age (GA), VPT very preterm 27-32 weeks GA, EPT extremely preterm (23 -31 weeks GA) as defined in this study<sup>4</sup>, sen (sensitivity), sp (specificity)



<sup>1</sup> Haastaja L, et al. Optimally score for the neurologic examination of the infant at 12 and 18 months of age. J Pediatr. 1999. doi: 10.1016/S0022-3476(99)70016-8. PMID: 10431108  
<sup>2</sup> Haastaja L, et al. Application of a scorable neurologic examination in healthy term infants aged 3 to 6 months. J Pediatr. 2003. doi: 10.1067/S0022-3476(03)00382-7. PMID: 14603891  
<sup>3</sup> Romeo DM, et al. Early psychomotor development of low-risk preterm infants: Influence of gestational age and gender. Eur J Paediatr Neurol. 2016. doi: 10.1016/j.ejpn.2016.04.011. PMID: 27142353.  
<sup>4</sup> Romeo DM, et al. Hammersmith Infant Neurological Examination in low-risk infants born very preterm: a longitudinal prospective study. Dev Med Child Neurol. 2022. doi: 10.1111/dmcn.15201. PMID: 35298030.  
<sup>5</sup> Romeo DM, et al. Neurological assessment of infants discharged from a neonatal intensive care unit. Eur J Paediatr Neurol. 2013. doi: 10.1016/j.ejpn.2012.09.008. PMID: 23062755.  
<sup>6</sup> Hay K, et al. Hammersmith Infant Neurological Examination Asymmetry Score Distinguishes Hemiplegic Cerebral Palsy From Typical Development. Pediatr Neurol. 2018. doi: 10.1016/j.pediatrneurol.2018.07.002. PMID: 30190180.  
<sup>7</sup> Novak E, et al. Early, Accurate Diagnosis and Early Intervention in Cerebral Palsy: Advances in Diagnosis and Treatment. JAMA Pediatr. 2017 Sep 1;171(9):897-907. doi: 10.1001/jamaopediatrics.2017.1689. PMID: 28715518.



# Scoring Aid

D Fehlings, A Makino, P. Church, R Banihani, K Thomas, M Luther, S Lam-Damji, B Vollmer, L Haataja,  
FM Cowan, DM Romeo, JM George, S Kumar, L Switzer (March 2024, Version 7)

Name: \_\_\_\_\_  
MRN: \_\_\_\_\_  
Date of Birth: \_\_\_\_\_

## **Hammersmith Infant Neurological Examination (HINE): Score Interpretation Aid for Children Receiving Neonatal Follow-Up Care**

Clinical history: \_\_\_\_\_

Brain imaging (if available): \_\_\_\_\_

# Scoring Aid

Visit	Child's Age (corrected)	Child's Global HINE Score	HINE Asymmetry Score	Corrected Age for GMA (if available)	GMA Category (if available)	Interpretation/Action	Discussed with family
1							<input type="checkbox"/>
2							<input type="checkbox"/>
3							<input type="checkbox"/>
4							<input type="checkbox"/>
5							<input type="checkbox"/>

# Scoring Aid

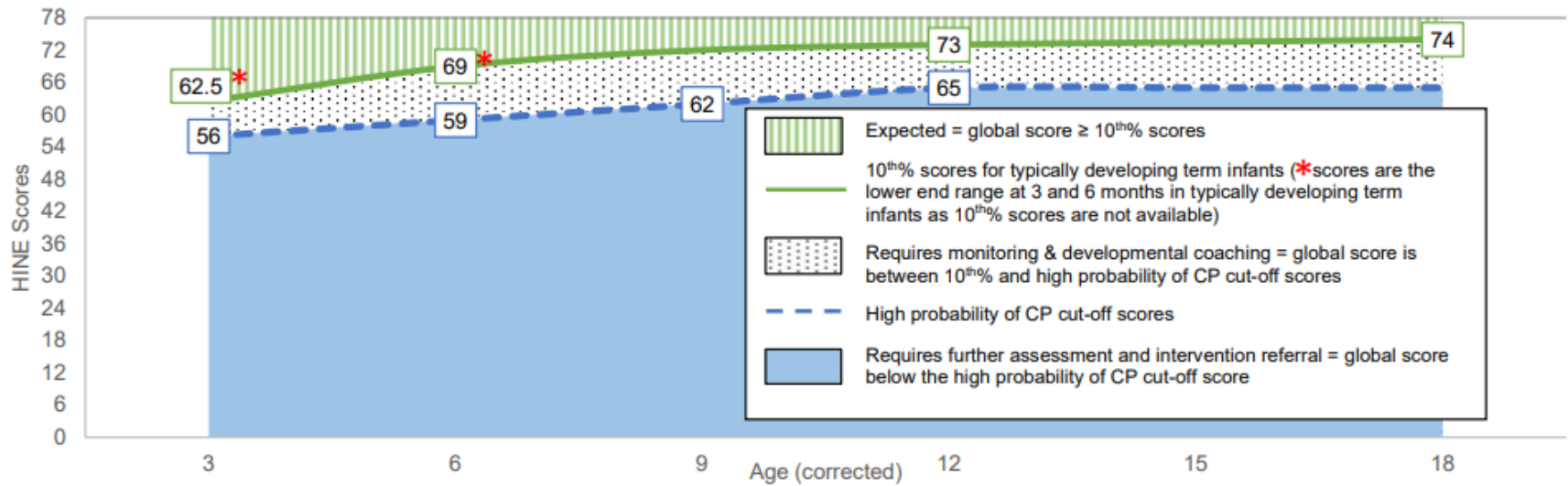
## HINE Scoring Aid Reference Information:

- Interpret HINE scores with clinical reasoning (e.g., term versus preterm, risk factors for CP, health co-morbidities, brain imaging, and General Movements Assessment (GMA)) when comparing to those from typically developing term infants. Follow the trajectory of HINE scores over time.
- The table provides expected global scores (median/ranges) for term<sup>1,2</sup> (column 2) and preterm infants<sup>3,4</sup> of various gestational ages (column 3,4) with typical 2-year development. 10<sup>th</sup> percentile scores (optimality scores) (equal to or above) which infants are considered to have typical neurological performance<sup>1,4</sup> are provided where available (column 2,4).
- Typically developing preterm infants have median global scores that range from 9 points at 3 months to 3.5 points at 12 months lower than typically developing term-born infants (Table column 3,4)<sup>3,4</sup>. There is also a wider range of scores around the median in preterms.
- CP cut-off scores (column 5) are global scores below which term and preterm infants with etiologic risk for CP (e.g., preterm, neonatal encephalopathy) have a high probability of developing CP<sup>5</sup>. Refer for early intervention.
- Infants with unilateral CP may not have low global scores but can have >5 asymmetries (often after 15 months of age) representing significant asymmetric neurological performance<sup>6</sup>. Refer for early intervention if >5 asymmetries are present regardless of infant's age.

Column 1	Column 2 Global Scores for typically developing term born infants <sup>1,2</sup>	Column 3 Global scores for low-risk LPT and VPT infants <sup>3</sup>	Column 4 Global scores for low-risk EPT infants <sup>4</sup>	Column 5 Cut-Off scores for high probability of CP <sup>5</sup>
Child's Age (corrected)	37-42 weeks GA Median (range)	mean GA 32 weeks (range 27-36) Median (range)	mean GA 27 weeks (range 23-31) Median (range)	All birth gestational ages but definitive data not available for EPT infants
3 months	<b>67</b> (62.5*-69) <sup>2</sup>	<b>62</b> (51-69) <sup>3</sup>	<b>58</b> (47-69) (10 <sup>th</sup> % 53) <sup>4</sup>	<b>&lt;56</b> (sen 96% sp 85%) <sup>5</sup>
6 months	<b>73</b> (69*-76.5) <sup>2</sup>	<b>66</b> (52-72) <sup>3</sup>	<b>67</b> (54-76) (10 <sup>th</sup> % 62) <sup>4</sup>	<b>&lt;59</b> (sen 90% sp 89%) <sup>5</sup>
9 months	N/A	<b>70.5</b> (57-76) <sup>3</sup>	<b>71.5</b> (62-78) (10 <sup>th</sup> % 67) <sup>4</sup>	<b>&lt;62</b> (sen 90% sp 91%) <sup>5</sup>
12 months	<b>76</b> (63-78) (10 <sup>th</sup> % ≥73) <sup>1</sup>	<b>72.5</b> (60-77) <sup>3</sup>	<b>73.5</b> (67-78) (10 <sup>th</sup> % 70) <sup>4</sup>	<b>&lt;65</b> (sen 91% sp 90%) <sup>5</sup>
18 months	<b>78</b> (71-78) (10 <sup>th</sup> % ≥74) <sup>1</sup>	N/A	N/A	N/A
	10 <sup>th</sup> percentile scores (10 <sup>th</sup> %): 90% of infants score at or above this level. * See legend in graph below.	Data for LPT and VPT infants are combined – medians are similar, but the range span is narrower for LPT than VPT	Note median scores are considerably lower for EPT infants than FT, LPT and VPT infants at 3 months.	A global score <40 at any age is highly predictive of CP GMFCS III-V at 2 years of age <sup>7</sup> .

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# Scoring Aid



**Hammersmith Infant Neurological Examination (HINE): Score Interpretation Aid for Children Receiving Neonatal Follow-Up Care**

Clinical history: \_\_\_\_\_

Brain imaging (if available): \_\_\_\_\_

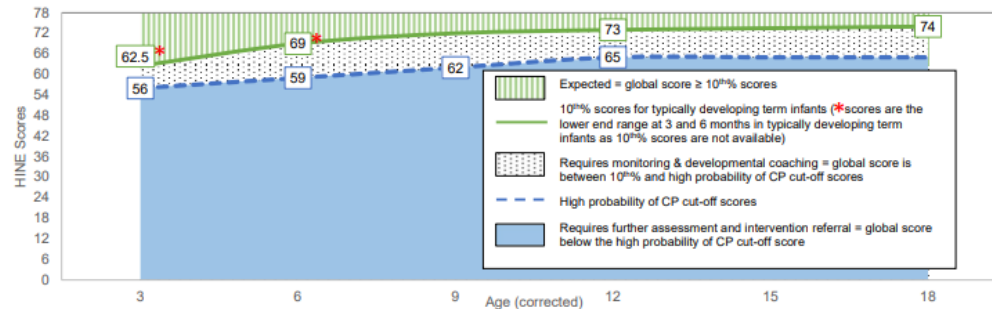
Visit	Child's Age (corrected)	Child's Global HINE Score	HINE Asymmetry Score	Corrected Age for GMA (if available)	GMA Category (if available)	Interpretation/Action	Discussed with family
1							<input type="checkbox"/>
2							<input type="checkbox"/>
3							<input type="checkbox"/>
4							<input type="checkbox"/>
5							<input type="checkbox"/>

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<sup>2</sup> Haastaja L, et al. Application of a scorable neurologic examination in healthy term infants aged 3 to 6 months. J Pediatr. 2003. doi: 10.1016/S0022-3476(03)00382-7. PMID: 14603891  
<sup>3</sup> Romeo DM, et al. Early psychomotor development of low-risk preterm infants: Influence of gestational age and gender. Eur J Paediatr Neurol. 2016. doi: 10.1016/j.ejpn.2016.04.011. PMID: 27142353.  
<sup>4</sup> Romeo DM, et al. Hammersmith Infant Neurological Examination in low-risk infants born very preterm: a longitudinal prospective study. Dev Med Child Neurol. 2022. doi: 10.1111/dmcn.15201. PMID: 35298030.  
<sup>5</sup> Romeo DM, et al. Neurological assessment of infants discharged from a neonatal intensive care unit. Eur J Paediatr Neurol. 2013. doi: 10.1016/j.ejpn.2012.09.008. PMID: 23062755.  
<sup>6</sup> Hay K, et al. Hammersmith Infant Neurological Examination Asymmetry Score Distinguishes Hemiplegic Cerebral Palsy From Typical Development. Pediatr Neurol. 2018. doi: 10.1016/j.pediatrneurol.2018.07.002. PMID: 30190180.  
<sup>7</sup> Novak I, et al. Early, Accurate Diagnosis and Early Intervention in Cerebral Palsy: Advances in Diagnosis and Treatment. JAMA Pediatr. 2017 Sep 1;171(9):897-907. doi: 10.1001/jamapediatrics.2017.1689. PMID: 28715518.

# Hammersmith - Mac Keith Press

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## Hammersmith Neonatal and Infant Neurological Examinations

### What are the Hammersmith Neurological Examinations?

The **Hammersmith Neonatal Neurological Examination (HNNE)** is a quick, practical and easy to perform examination but requires some learning and experience to perform well. There are 34 items assessing tone, motor patterns, observation of spontaneous movements, reflexes, visual and auditory attention, and behaviour. It was initially developed by Dr Lilly Dubowitz and Professor Victor Dubowitz in 1981, and updated with Dr Eugenio Mercuri, in 1998. Many studies have been performed using it in different clinical groups of full term and preterm infants at different ages within the neonatal period.

The **Hammersmith Infant Neurological Examination (HINE)** has similar structure to the neonatal exam and consists of 26 items that assess different aspects of neurological function: cranial nerve function, movements, reflexes and protective reactions and behaviour, as well as some age-dependent items that reflect the development of gross and fine motor function. The HINE is aimed to be used for infants between 3 and 24 months of age.

Today, the HNNE and the HINE are used throughout the world in the clinic and for research. Both the HNNE and the HINE have been standardised in large cohorts of typically developing children. The examinations are easily recorded on standardised proformas, simplifying the documentation of findings and comparison between sequential examinations. The examinations can be scored to enable classification into optimal and sub-optimal neurological categories. The scores of the HINE can also be used to enable detection of high risk of cerebral palsy (CP) at an early age, and prediction of independent sitting and walking in high-risk infants.

By subscribing to the teaching videos you will be supporting the work of the Editors and Mac Keith Press to provide accurate and correct information about the examinations. We will be making access freely available to users in low-income countries – as well as those in Ukraine – and we will subsidise access for those in lower-middle and upper-middle income countries (using the World Bank definitions).

**The Hammersmith Neurological Examination Proformas (HNNE and HINE) may not be adapted in any way without written permission from the authors and Mac Keith Press. Please contact**

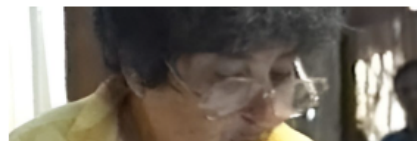
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- ▶ If you have any questions, please email us:  
**[HINE@hollandbloorview.ca](mailto:HINE@hollandbloorview.ca)**

# References

## **HINE Scoring Proforma**

1. <https://www.mackeith.co.uk/hammersmith-neurological-examinations/hammersmith-neurological-examinations-subscriber-content/recording-and-scoring-proformas/>

## **HINE Scoring Aid**

2. <https://onlinelibrary.wiley.com/doi/10.1111/dmcn.15977?af=R>