Hammersmith Infant Neurological Examination (HINE)

(update June 2025)

Guidance notes for completion of the proforma

Main references (others at end)

- Haataja L et al. Optimality score for the neurologic examination of the infant at 12 and 18 months of age. J Pediatr 1999;135:153-61
- Neurological Assessment in the first 2 years of life. Ed Cioni G & Mercuri E. 2008 Clinics in Developmental Medicine 176; ISBN: 978-1-898683-54-4; Mac Keith Press (now Wiley)
- https://www.mackeith.co.uk/hammersmith-neurological-examinations/

The Hammersmith Infant Neurological Examination (HINE) is a relatively short exam that is not difficult to learn, does not require expensive equipment and is applicable in any clinical setting. The 26 neurological items are divided into 5 sections, (cranial nerves, posture, movements, tone, reflexes and reactions), which can be readily recorded on the HINE proforma and then scored. Additionally, there are two sections, which are not included in the score, one documenting motor developmental milestones and age at which they were achieved and the other recording the child's behaviour in terms of responsiveness and interaction during the examination.

The examination has been validated for term and preterm children from age 3 months to 18 months in terms of global scores and prediction of gross motor outcomes i.e., cerebral palsy and achieving independent sitting and walking. It has been used up to age 2 years in many studies though at that age some of the items in the reflexes and reactions section and those involving lifting may be difficult for the examiner as the children may deliberately flop or dislike being handled, making those items difficult to assess.

Whilst the exam documents the neurological status of any infant, the predictive value of the scoring for sitting, walking and cerebral palsy (CP) was validated in preterm and term infants at risk for CP. It has not been validated in large cohorts of infants with genetic syndromes, metabolic or congenital neuromuscular disorders or congenital heart disease, so some caution should be taken in using the scores for prediction of motor outcomes in these populations.

The examination can be completed in 10-15 minutes. It is best performed on a bed or on a mat on the floor - if that is very difficult in an older child, because the child is fractious and clingy some items can be done on a parental / carers lap provided it is possible to lie the child down (see demonstration in the video). It is best to do the exam on a firm flat surface.

Recording the examination

In order to record (and later score) the examination, mark the response, i.e., what you see when you administer an item, by circling the appropriate picture (stick figure drawing) on the HINE proforma. Scoring (i.e., calculating the global score) is better done later.

- You do not have to assess items in a particular order. However, it is often best to undertake the items assessing visual attention and auditory responses first but be

guided by the infant's mood. Make sure to watch for changes in facial expression and spontaneous movements throughout the examination.

- If a response does not fall clearly into one of the options offered but falls between two options (columns) then mark across the vertical line dividing the two boxes

- If the response is asymmetrical mark the observation twice, once for left (L) side and once for right (R) side. You will see that in many boxes L and R are written. Circle the appropriate side. Asymmetries can be within the same box or in different boxes for any one item. Note any asymmetry by writing A in the right-hand margin of the form by the item. In the summary on the front page note the total number of asymmetries, which sites were asymmetrical and whether the laterality was consistent or not.

- If there are two drawings in any box mark the one closest to what you see.

- If there is more than one position in which to assess an item e.g. leg posture in the posture section (you can do this in lying, sitting and standing), score in each position and take the average of the scores - this is further described in the posture section for legs. This approach applies similarly for foot posture.

- If the response or observation that you see is not offered on the proforma, draw what you find or describe it in writing. This might be because the child is fractious or uncooperative so if possible repeat the examination after a short time. However, it is not recommended to repeat manoeuvres many times. If you still find you cannot decide which box is appropriate then leave the item unscored – see information on page 3 about overall scoring with missing items.

Scoring neurological findings

The scored section of the exam comprises 26 items assessing cranial nerve function (5), posture (6), movements (2), tone (8), and reflexes and reactions (5).

- The maximum score for any item is 3 and appears in column 1. The score for findings in column 2 is 2, in column 3 is 1 and in column 4 is 0. A score of 3 is generally optimal but the typical infant may not score 3 for every item and for some tone and reflex items scores <3 are the norm in younger children under 7 months. A score of 3 given for each item of the exam would give the maximal score of 3 x 26 = 78. As you move across the proforma page from left to right, there are 4 columns and the scores for any item reduces from 3 to 0.

- If the response to an item is not clearly that depicted in column 1 (i.e., score 3) but is neither in columns 3 or 4 (i.e., scores 1 or 0) then mark column 2 (score 2) unless you think that is quite inappropriate – in which case describe. Either don't score the item or give a score nearest to that you feel is most accurate.

- If the response to an item is asymmetrical and in two different boxes mark the column for 1 side e.g., column 2 and the column for the other side, e.g., column 3 – then add the scores for those columns and divide by 2 - in this example we get (2 + 1)/2 = 3/2 = 1.5. Note the asymmetry in the right-hand margin of the form whether the asymmetries are within the same or in different boxes.

When you are finished, add up the number of asymmetries in the summary. This may help in predicting a hemiplegia (i.e., unilateral CP) though be aware that small asymmetries are not uncommon in the early months. Note that in the paper by Hay K et al (Pediatric Neurology 2018) reporting that having >5 items with an asymmetrical response was associated with unilateral (hemiplegic) CP, the infants had a median age of **15 months**, when a hemiplegia is likely to be clinically obvious.

Prediction of outcomes from global scores

Note: For outcome prediction in preterm infants corrected ages (CA) are always used.

- At age 12 months in term-born infants scores >72 are optimal and at 18 months scores >73 are optimal (Haataja L et al 1999). In younger infants they are lower, being around 65 (range 62-69) at 3 months and increasing gradually to the range seen in older infants by 6-7 months. (see Haataja L 2003, normal full term infants and Romeo D et al 2016 and 2022, ex-neonatal term infants with a normal brain scan and normal 2-year outcome)

- *Walking and sitting*
  At 6-9 months scores >66 (infants born at term) and >60-64 (infants born preterm) are associated with independent walking and scores >40-60 (term and preterm term) are associated with independent sitting but most children are not walking at 2 years (Haataja L et al 2001, Frisone M et al 2002, Ricci D et al 2006, Romeo D et al 2009). In the study by Haataja L et al 2001 in term infants with hypoxic-ischemic encephalopathy, only 13% with scores between 40-66 could walk independently at 2 years but this increased to 25% at 4 years.

- *Cerebral palsy (CP)*
  - Predictive scores for CP overlap with those for walking and sitting but are not the same.
  - A score <57 at 3 months CA and <66 at 12 months CA is highly predictive of bilateral CP (Romeo et al DMCN 2013). However at 3 months in extremely preterm infants scores predicting CP may be lower than the cut-off score given above as median scores in infants with good 2-year outcomes are reported to be 58 (47-69), (Romeo DM et al DMCN 2022).
  - After 5 months a score <60 (Romeo et al DMCN 2013) puts a child at-risk of CP but this includes all severities and types of CP. In general the lower the score the more severe the CP.
  - A score <40 at any age almost always indicates severe CP.
  - Remember that children going on to develop a unilateral CP (hemiplegia) may not have low scores.
  - Please see the teaching videos and published papers for more detail on prediction using HINE scores for term and preterm infants of different gestational ages.
  - Prediction of mobility and CP is good using HINE scores, but it is never 100%. Clinical circumstances, the site and type of injury seen on brain imaging and the pattern of neurological findings are always important to consider.
  - For a useful one-page summary of prediction of CP from HINE scores, please see Fehlings D et al. DMCN 2024.

- Scoring with missing items
  Be very careful making predictions from scores when you have missing items. The missing items may be very important and tip the balance. Make a note of why you were unable to undertake these items.

  If you are undertaking a study comparing e.g., groups of children, then we have accepted that up to 5 but not more missing items can be allowed and the global score would be calculated out of 63 and not 78. You need to document that this is what you have done.

Section 1 Cranial nerve function

Some of this section will be observable whilst talking to parent/carers prior to the formal examination.

If the child has glasses or uses a hearing aid examine without using these aids and note the findings – use this for scoring. Ideally, also see whether the response seems better using the aids.

- Facial appearance
  Observe the child´s face for a range of movements and symmetry, and e.g., any tendency to have the mouth open or dribble. If at the end of the exam you do not identify a specific problem, but you think there is some paucity of movement mark column 2 (score 2)

- Eye movements
  First observe spontaneous eye movements. Then present the child with a clear visual target (preferably black and white circles or face – we no longer recommend a red woolly ball) and observe whether the child can fix on it. Then move the target horizontally and then vertically and note any deviant eye movements, either intermittent or continuous, e.g., strabismus (squint), nystagmus, ptosis etc. Make sure the child does not compensate for any limitation of eye movements by moving their head. The main aim of this item is to note abnormal or limited eye movements.

- Visual response
  For this you need to try to get the child to follow a clear target fully vertically, horizontally and in a circular manner noting their attention to the target. The target is best held at a distance of 20-30cm from the baby and moved at a steady speed of about 3 degrees/second (Ricci D et al Early Hum Dev 2007) The distance is not so critical in older children unless they are having difficulty following the target. Make sure the child moves their eyes fully and does not compensate for any difficulty they may have by moving their head.

  Do not speak to the child yourself while testing, and make sure there are no sounds that might interfere with interpreting the reason for the eye movements. Also do not have attractive visual objects within the child´s field of view. If the child does not follow the target, 1. try using a more interesting target e.g. a face instead of circles, or 2. try a simpler target.

- Auditory response
  Ideally have someone out of the child´s line of vision to help you test the auditory response. Test each side separately. Be careful that there is not a very attractive visual stimulus (that may include your face) in the child´s field of view as they may then ignore the auditory stimulus. If testing hearing is difficult and parents report that the child has had a formal hearing test and you have no concerns you can assume a score of 3 but make a note about this. It is better to test hearing yourself as a hearing can deteriorate after the neonatal period due to e.g., glue ear or CMV. The test in the HINE is a behavioural test showing the child has processed the sound as well as heard it - it is thus not the same as auditory brainstem evoked potentials (ABERs) or otoacoustic emissions (OAEs).

- Sucking/swallowing
  If a child does not have definite difficulties with sucking, chewing or swallowing but reportedly does not feed well mark column 2 (score 2). Ideally watch the child feed but if this is not possible, ask the parents/carer if they find difficulties in feeding or have concerns. Note if the child dribbles or does not close their mouth well. If concerned refer for more detailed assessment.
  Note on the form if a naso-gastric tube or PEG (per-cutaneous gastrostomy) is in place though this does not necessarily mean that the child cannot suck or swallow and does not automatically mean the child would score 0 for this item.

Sections 2-5

Ideally the following items should be assessed with the child undressed down to vest and diapers. However, if undressing the child causes upset at least remove shoes and socks, trousers and thick jumpers.

Section 2 Posture items

- **Head posture in sitting** – for younger children you will have to support them in sitting sufficiently so that you are only assessing head posture. You support them as low as safely possible around the hips or trunk, not around the shoulders.

- **Trunk posture in sitting** – in order to obtain a score of 3 the back needs to be really straight most of the time. Again, you may need to provide some support but this should be low down the trunk, not around the shoulders. If a child needs support high up around the shoulders than they would score 0 for this item. The point of the test is to see how well a child can support itself and therefore they should be supported as low down as safely possible.

- **Arm postures** Observe during the exam. Record asymmetries. Arms postures can be observed in any position, (best lying in the younger infant, but also in sitting and standing when the infant is confident in these positions). The arm should be easily in line with the trunk from shoulder to elbow, and mostly in a neutral position from elbow to wrist i.e. not supinated but can be partially pronated. Internal and external rotation can be at either shoulder or elbow. No posture should be fixed and specifically abnormal postures are listed on the proforma.

- **Hand postures** Observe during the exam. The hands should be mostly open without fixed postures. Specific abnormal postures are given on the proforma. Record asymmetries

- **Leg posture** How you test this depends on the age/abilities of the child. Observe leg posture in all 3 positions i.e., lying, sitting and standing, if possible. For sitting the child needs to be on a flat surface with legs out straight in front (called long sitting; this item cannot be tested with the child sitting on a chair). For children that are not yet sitting independently observe the leg posture from the hips when supine and in supported sitting. If the child is not yet weight-bearing observe leg posture only in supine and sitting. Weight bearing means the child has developed some active weight bearing, not the reflex seen in younger children. Active weight bearing is usually present from around 5-7 months. Make an overall assessment of your observations – remember only 1 score is given for this item. If e.g., the observation in sitting is in a different column from that in lying (or standing) take an average of the 2 or 3 scores. Record asymmetries.

  Although on the HINE proforma for this item the back has to be straight in sitting, the focus here is on the legs and if the back is slightly rounded but the legs quite flat on the surface you can accept this.

- **Foot postures**
  Observe the foot posture in relation to the lower leg - many children will appear to have some external angling or eversion of the foot but generally this comes from the hip and is not genuinely present at the ankle. If the feet are central (score 3) but the toes intermittently curled down (score 1), take the mean score. Record asymmetries

Section 3 Movements

These items can be observed throughout the visit but it is necessary to make a point of watching the child and observe the quantity and quality of movements. Some children will have slightly jerky movements, i.e., in column 3 but rarely do they fall into column 4. If you judge that the movements are not optimal but do not fall into column 3 then mark column 2. Remember that this section is not meant as a substitute for a GM assessment and most infants you are assessing are not within the age range of GM assessment. It is more a general impression of the overall movement quantity and quality during the period you are observing the infant.

Section 4 Tone items

This section should be done with the child lying on a flat surface such as a bed or on a mat on the floor. However, if the child is very reluctant to lie on the bed/floor you may achieve some items by laying the child on both your own and the parent's/carers lap (this is shown in the video, see earlier comment- page 1). It is best to do this by sitting in a chair opposite the carer so that your knees are almost touching and then sit the child on the carer's lap and pull the child´s legs slowly towards you so that the child is lying across your two laps. You may be able to achieve a few items of the examination that way. Always record asymmetries.

- **Scarf sign** Pull the arm across the chest gently but firmly keeping the child's head in the midline. If the arm can be pulled across just beyond the ipsilateral chest wall any distance to just before the contralateral chest wall score 3 (column

1). Most infants will be to the right in column 1 If the elbow does not go beyond the ipsilateral chest wall or reaches beyond the contralateral chest wall score 0 (column 4). If the elbow goes past a line going though the contralateral cheek, mid-clavicle indicating mild hypotonia score 1 (column. 3) Generally speaking, in younger infants the elbow will move across towards the midline but in older infants it may go beyond.

- **Shoulder elevation** Hold the arm at the wrist, lift it up vertically and continue until the arm lies alongside the head on the bed. You usually meet some resistance, which can easily be overcome by waiting a couple of seconds (column 1, score 3). If resistance is considerable but with time you can extend the arm fully (score 2); in infants with general hypotonia and also in some ex-preterm children little resistance is met to this manoeuvre (column 3, score 1). If resistance is such that you cannot raise the arm, mark column 4, score 0. Repeat the shoulder elevation manoeuvre on each side to feel for mild asymmetries. Avoid making a circular movement as if assessing the full range of shoulder movements. This is not the point of the item, just lift the arm up along the side of the head.

- **Supination and pronation** Extend the elbow as much as easily possible and then hold the arm just below the elbow with one hand. With your other hand hold the wrist and rotate the child´s forearm at the wrist, supinating and pronating it through 180°.

- **Hip adduction** Lie the child horizontally, ideally with a loosened nappy. Have the legs straight at hips and knees, lying flat on the mattress. First keep the legs together in the midline and then gently abduct them as far as you can, keeping the legs straight in line with the bed i.e., do not flex the hips, and remember to keep the knees extended.

- **Popliteal angle** Lie the child on their back. Flex the hips so that the anterior aspect of the thighs are touching the abdomen keeping the child's bottom on the bed as much as possible - if you let the bottom lift the measured popliteal angle will be bigger. Then, keeping the thighs on the abdomen, extend the lower legs at the knees as far as they easily go and estimate the angle behind the knee. *The test was standardised testing both legs together.* If this proves impossible (e.g., the child is wriggling a lot, or they insist on extending their legs) then you can test one leg at a time which makes it easier to keep the bottom on the bed. But make a note you have done this and be careful to look for asymmetries.

- **Ankle dorsiflexion** It is important to do this item with the leg straight at the knee and hip. Hold the knee down on the bed by putting the flat of one hand on the kneecap, and at the same time place your other hand flat against the sole of the foot and dorsiflex the ankle as far as it naturally goes. Be careful not to elicit a toe grasp/plantar response. Estimate the angle between the dorsum of the foot and the lower leg. Some children will voluntarily resist this manoeuvre but actually are flexible so do this slowly but firmly. Some children will have an involuntary resistance and then a sudden give; if this is the case describe and make a note in the empty box on the right. Specifically testing for a catch or for clonus can be done but are not part of this item or scored in the HINE.

- **Pull to sit** Hold the child by both wrists, and pull them up from lying, watching the position of the head as they come up. It you feel they under-perform repeat the manoeuvre. This item can be difficult to score if they are crying and deliberately holding their head back so repeat when they are calmer. If they are very floppy be sure to keep your hand under the head to give needed support.

- **Ventral suspension** Hold the child around the abdomen in a horizontal position. For safety, do not hold the child just with one hand under the abdomen. Some children may be too heavy to comfortably hold around the abdomen in this position. They may also mess around or not like being held horizontally in the air and deliberately flop down. If this happens write this down rather than score the item. Try repeating the item when they may be more amenable.

Section 5 Reflexes and Reactions

- **Tendon reflexes**: It is best to test tendon reflexes while children are lying but they can be done in other positions. The most important thing is that the muscles around the tendon you are tapping are relaxed. It can be difficult to use a hammer with some children and at least for knee jerks you can tap sharply with your fingers on the tendon when the child relaxes (you need to practice doing this). Always be careful to tap with a hammer on the tendon and not the kneecap or heel which is painful. For the biceps jerk hold the elbow and put your thumb over the biceps tendon and hit your thumb. Occasionally you can feel the reflex well but not see it – this can be scored as normal.

- **Arm protection:** To do the test lie the child down and place your hand on the hip contralateral to the arm you will pull the child up by. Then pull the child slowly upwards by the wrist and see whether the child puts their free arm down on the bed to support themselves. To score 3 there needs to be an active response in the arm and the child needs to open their hand and spread the fingers and weight bear on the surface. If the child's arm goes actively down but not fully weight bearing or the hand does not open score 2, if the arm goes partially down but not to the bed score 1 and if the arm remains flexed up by the body score 0. Repeat the other way around to test the other side. There needs to be an active component in the response to score, not just the arm flopping down on the mattress. If a child is very hypotonic then carry out this manoeuvre with extra care and do not persist if there is no early response or it seems to hurt e.g. at the shoulder you are pulling up.

  The arm protection response precedes the lateral saving response which is elicited when the child is sitting and puts their arm out to save themselves when tilted sideways – this is not tested in the HINE. Any child who can sit independently and stably must have an arm protection response though it may be better on one side than the other. Some older children won't respond by "saving" themselves as they like to play and fall. Describe on the record sheet if you think this the case, rather than score them wrongly. If they obviously have this saving reaction mark them in column 1 (score 3).

- **Kicking in vertical suspension:** Hold the child vertically some way below the armpits, with their back to you so they can see their parent or carer, and observe whether they kick their legs equally and well. Sometimes it is necessary to get someone to tickle the feet a little to encourage a response. One is mainly looking for subtle differences in whether they kick one leg more than the other. If they are too heavy to lift or deliberately flop or stiffen say so and don't score. Kicking in this position is not the same as kicking when they are horizontal or in sitting – it is a more difficult task. You can ask the parent/carer to hold the child up in this way if the child prefers that.

- **Lateral tilt:** Lift the child vertically and hold them just above the hips, (not high up under the armpits, as then they have no need to use their trunk muscles) with their back towards you so they are facing their parent/carer. Then tilt sideways (not fast) by about 45 degrees and see/feel the response of the trunk muscle under your upper hand. Some older children may be rather heavy to lift and some may deliberately flop down. To score in column 1 (score 3) (see drawing) they must have a brisk response not only with the trunk curving upwards but with leg and shoulder elevation. If there is some upward movement but not full, score 2 and if you feel the trunk muscles working under your upper hand and the trunk is maintained horizontal with no upward curving score 1. If the child flops downwards score 0. Remember, you should not tilt them too fast and you do not need to tilt them completely horizontally.

- **Parachute reflex:** Hold the child just above the waist and tilt briskly forwards towards a bed or table some distance beneath them. Look for a brisk forward symmetrical arm response and placing open hands on the surface.

  This response is seldom fully present before 6 months post-term age and you do not need to test it. If you test it before age 6 months, do not score it in the HINE, i.e.it is always a score of 0 up to age 6 months post -term

  After 6 post-term months age, score 3 if the reaction is present and symmetrical or score 1 if absent. If partial (e.g., hands not open or arms not fully down) score 2. If the response is asymmetrical, score 3 (column 1) for the side with a normal response and score 2 if partial and 1 if absent for the abnormal side noting which side is present/absent. Mark the asymmetry in the right-hand column). Calculate the score as for any other asymmetrical item.

  NB in the book Neurological Assessment in the first 2 years of life. Eds Cioni & Mercuri, 2008, pages 34-35, the scoring is slightly differently described – this is not how the item has been scored in recent usage and this system should not be used.

Motor Milestones and Behaviour

We do not score these items but they are an important record of motor development and state during the examination.

The pictures and descriptions for the motor milestones are obvious.

- Ask whether the child played with their toes when they were younger - note any asymmetry.
- Ask if the child rolls both ways and through both sides – again note any asymmetry.
- Make a comment if they commando crawl(ed) and if they bottom shuffle(d).
- Note the age of independent walking (5 steps).

The observations in the behaviour section are numbered 1-6 for conscious state, 1-5 for emotional state and 1-4 for social orientation. This totals maximally 15 and can be noted on the front sheet. Whilst the information in this section is both important and useful it is not part of the HINE global score.

References A full list is available on our website

https://www.mackeith.co.uk/hammersmith-neurological-examinations/

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Update 10th June 2025

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