Hold arms horizontally: wing beating tremor (Wilson disease)

Knee and ankle reflexes
- Diminished (vitamin E deficiency)
- Delayed return (hypothyroidism)

Sensation: diminished (vitamin E deficiency)

OTHER

Request inspection of:
- Urine: dark (cholestasis)
- Stool: acholic (cholestasis); blood (portal hypertension)

Urinalysis
- Bilirubin (hepatobiliary disease; its absence implies unconjugated hyperbilirubinaemia)
- Urobilinogen (increased in haemolysis, and hepatic dysfunction)
- Blood (UTI)
- Nitrites (UTI)

Temperature chart (hepatitis, UTI, chronic active hepatitis)

CLD = chronic liver disease; IBD = inflammatory bowel disease; UTI = urinary tract infection.

Nutritional Assessment

The simplest method of approach to this case comprises 3 successive components.

1. Assessment of growth parameters.
2. Assessment of fat and protein stores.
3. Assessment of other nutrients, systematically.

First, introduce yourself to the child and the parent. Ensure the child is fully undressed, then stand back and inspect the child carefully. Visually scan for subcutaneous tissue and muscle bulk. Comment on the child's height and weight, request the pèrcentile charts, and interpret these. If only one measurement is given, request previous measurements to observe their progression. Work out the weight age and height age; compare these and comment. Next, if the child is underweight, work out the weight for height, to quantitate the difference in kilograms between this value and the child's actual weight.

On interpretation of percentiles, the common finding is poor weight gain, but height can also be significantly decreased by chronic disease, protein calorie malnutrition (PCM), zinc deficiency, and rickets. Head circumference can be decreased in PCM, but increased in vitamin D deficiency rickets.

After interpreting the percentile charts, demonstrate the amount of subcutaneous fat tissue by examining the skin fold thickness, between your thumb and index finger, at the midarm over biceps and triceps, at the axillae, the subscapular and suprailiac regions. Demonstrate muscle bulk at the arms, thighs and buttocks, muscle wasting being best demonstrated over these areas, particularly the buttocks (glutei). In infants, poor muscle bulk can be reflected by hypotonia on picking the child up.

The next step is a systematic general examination directed at detection of various deficiencies; it commences at the hands, then continues up to the head, and then essentially head to toe. Figure 16 outlines the order of examination, and the list at the end of this section gives additional information. Each deficiency sought is given in parentheses after the relevant physical sign.

Figure 16. Nutritional assessment.

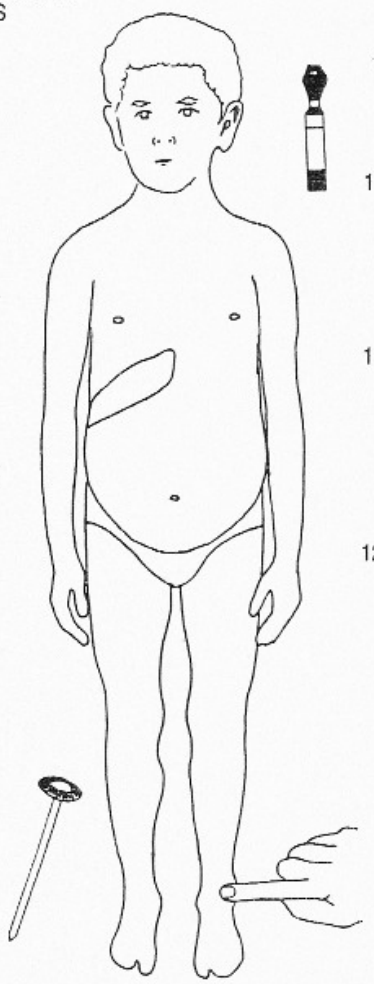
1. INTRODUCE SELF

2. GENERAL INSPECTION
   - Position patient: standing, fully undressed, then lying
   - Parameters
     - Weight
     - Height
     - Head circumference
     - Percentiles
     - Weight age versus height age
     - Weight for height (quantitate)
   - Sick or well
   - Irritability
   - Nasogastric tube
   - Intravenous access
   - Posture
   - Skeletal deformity
   - Potbelly

3. DEMONSTRATE FAT AND PROTEIN STORES
   - Subcutaneous fat
     - Mid-arm
     - Axillae
     - Subscapular
     - Suprailiac
   - Muscle bulk
     - Biceps
     - Triceps
     - Quadriceps, Glutei

4. SKIN
   - Pallor
   - Jaundice
   - Bruising
   - Dermatitis
   - Erythema nodosum

5. HEAD AND NECK
   - Head
   - Hair
   - Eyes: detailed examination
   - Mouth
   - Teeth
   - Tongue
   - Gums
   - Neck



6. UPPER LIMBS
   - Palms, nails
   - Pulse
   - Wrists, forearms
   - Blood pressure

7. CHEST WALL
   - Rib rosary (vitamins C, D)
   - Sternal deformity (vitamins C, D)
   - Harrison's sulcus (vitamin D)
   - Sacral oedema (PCM, CLD)

8. ABDOMEN
   - Distension
     - Ascites (PCM, CLD)
     - Weak abdominal muscles (PCM, vitamin D)
   - Hepatomegaly (fatty infiltration with PCM, linoleic acid)
   - Hepatosplenomegaly (CLD, zinc)
   - Pubertal delay (zinc)

9. GAIT
   - Full gait examination (vitamins B_1, B_6, B_{12}, E)
   - Examine back (vitamin D)

10. LOWER LIMBS
    - Palpation
      - Muscle bulk
      - Ankle oedema
      - Tenderness
    - Neurological examination

11. CARDIOVASCULAR SYSTEM
    - Full praecordial examination, looking for
      - Cardiomegaly (vitamin B_1, phosphate, selenium)
      - Cardiac failure (vitamin B_1, phosphate, anaemias)

12. OTHER
    - Urinalysis
      - Low specific gravity (CRF)
      - High specific gravity (dehydration)
      - Glucose (diabetes)
    - Stool analysis
      - Malabsorption
      - Giardiasis
    - Temperature chart (hypothermia with PCM)

fat crystals (coeliac disease) or globules (cystic fibrosis), low pH and reducing substances (carbohydrate intolerance), or giardia (cysts or vegetative forms). It is also worth mentioning inspection of any vomitus for bile (obstructive bowel lesions) or blood (portal hypertension); temperature chart for infection; and watching the mother feeding the child, noting their interaction, feeding technique and any maternal anxiety.

The examiners may ask how you would investigate the problem. If undernutrition seems possible, then a common approach would be to admit the child to hospital and document whether the child can gain weight with adequate calories, which confirms undernutrition. If the child does not gain weight despite adequate calories, then investigation for malabsorption would be appropriate (see page 98).

Poor Feeding

This is a very similar case to failure to thrive, but may be less long standing, such that poor somatic growth has yet to occur. The approach is essentially the same in content, with some additions, but the order is changed.

Commence with general inspection, as outlined in the previous section, and comment on parameters and percentiles. The resting respiratory rate is a guide to a cardiac or respiratory cause, and obviously abnormal posturing and movements may indicate a neurological cause (e.g. cerebral palsy, spinal muscular atrophy).

Next, watch the child feed; this will help to clarify the nature of the feeding problem, whether it is local or general, and if general, which system is affected.

Start the examination with the head, looking for local causes first, if no initial clues are apparent after inspection. If there are suggestions of specific problems, such as an infant with an alert face but paucity of movement, then 'go for the money', and 'chase' all the relevant clinical signs for the diagnosis that you suspect (in this example, demonstrate all the findings recognized in Werdnig-Hoffmann spinal muscular atrophy).

Note if there is any regurgitation of food through the nose, or any vomiting associated with feeding. Look for local structural problems, such as cleft palate; check the gag reflex and note the quality of the suck. If the infant is breathless, check for nostril patency by holding a shiny metal object, such as one arm of a stethoscope, immediately below the nostrils, and inspect for condensation at the point underneath. The remainder of the head examination procedure suggested for failure to thrive is appropriate here.

The remainder of the general examination can also follow the failure to thrive pattern, that is, assessing the cardiorespiratory system, abdomen, and neurological system, as well as checking the blood pressure (renal disease), urinalysis and the temperature chart.

Examine the skin thoroughly before laying hands on the patient. There are numerous dermatological manifestations of many deficiencies. Some of the relevant deficiencies include marked flakiness (PCM), dryness (linoleic acid, vitamin A), bruising (vitamin C, K), pellagra (niacin) or hyperpigmented hyperkeratosis (zinc deficiency).

Examine the child's hands next. Look at the palms for crease pallor (anaemia associated with several deficiencies), or palmar erythema (chronic liver disease, CLD), and the nails for koilonychia (iron), brittleness (iron, protein), leuconychia (CLD), or clubbing (cystic fibrosis, CLD, Crohn disease).

Feel the radial pulse for bradycardia (PCM, iodine) or tachycardia (vitamin B_1, dehydration). Check the wrists for palpable epiphyseal enlargement (vitamin D), forearms for tenderness (vitamin C), and joints for swelling (vitamin C). Take, or request, the blood pressure, supine and standing (sodium, dehydration) and offer to look for Trousseau's sign (cuff inflated to greater than systolic pressure for 3 minutes) at the end of the examination (calcium).

Next, examine the head and neck. Look for thinning of hair or areas of alopecia (linoleic acid, zinc), dyspigmentation of hair (PCM), and feel the hair for dryness (iodine) or excessive pluckability (PCM).

The eyes are the next area on which to focus, and there are many signs possible here (see list). In particular, look at the conjunctivae for pallor (iron, copper, B group vitamins, folate), or dryness and wrinkling (vitamin A), or Bitot's spots (silver plaques of desquamated epithelial cells and mucus) on the bulbar aspect (vitamin A). Look for scleral icterus (vitamin B_{12}, CLD), corneal dryness, wrinkling or clouding (vitamin A), or opacification (vitamin A, zinc). Quickly assess the external ocular movement (vitamin E), and check for photophobia (riboflavin, zinc). Offer fundoscopy for optic nerve inflammation (vitamin B_{12}), or atrophy (vitamin B_1); this will usually not be required.

Next, percuss over the facial nerve, for Chvostek's sign (calcium). Then, inspect the mouth for angular cheilosis (iron, riboflavin), gums for swelling or bleeding (vitamin C), teeth for caries (fluoride), enamel defects (vitamin D), or looseness (vitamin C), tongue for moistness (hydration), glossitis (B group vitamins), buccal mucosa for reddening or ulceration (B group vitamins) or petechiae (vitamin C). Examine the neck for goitre (iodine).

Examine the chest for sternal deformity (vitamin C, D), or any 'rib rosary' (vitamin C, D).

Next examine the abdomen for evidence of pot belly (weak abdominal musculature, coeliac disease), hepatomegaly (PCM, linoleic acid), hepatosplenomegaly (CLD), or ascites (PCM, CLD). Assess Tanner staging for pubertal delay (zinc).

Now, walk the child, looking for evidence of cerebellar ataxia (vitamin E, zinc), or peripheral neuropathy (vitamins B_1, B_6, B_{12}). Check for Romberg's sign (vitamins E, B_{12}). While the child is up, check the back for scoliosis, lordosis or kyphosis (vitamins D, C) and look again for any evidence of bow legs or knock knees (vitamin D). Proceed with a lower limb examination, feel for ankle oedema (PCM, CLD), test muscle tone (decreased in PCM). Check muscle power for weakness (PCM, sodium, potassium), tap out the knee and ankle jerks, which may be decreased (vitamins, B_1, B_6, B_{12}, E), increased (vitamin B_{12}), or have slowed return (iodine). Examine sensation for peripheral neuropathy (vitamins B_1, B_6, B_{12}, E), or posterior column dysfunction (vitamins B_{12}, E).

Examine the heart for cardiomegaly (vitamin B_1, phosphate, selenium) or congestive cardiac failure (vitamin B_1, phosphate, anaemia).

Finally, request the urinalysis for specific gravity (high with dehydration, low with chronic renal failure) and glucose (diabetes), and the stool analysis for evidence of malabsorption or giardiasis.

Additional Information

Details of possible findings on nutritional assessment

INSPECTION

Activity, awareness (PCM)

Irritability (vitamin C, iron, coeliac)

Nasogastric tube

Intravenous access for total parenteral nutrition

Posture

- 'Frog leg' (vitamin C)
- Bow legs (vitamin D)

Prominent wrists, ankles (vitamin D)

Rib rosary (vitamin C, D)

Harrison's groove (vitamin D)

Potbelly (PCM, coeliac, vitamin D)

SKIN

Pallor (vitamins A, B_1, B_2, B_6, B_{12}, C, E, folate, iron, copper)

Jaundice (CLD, vitamin B_{12})

Bruising (vitamins C, K)

Poor wound healing (vitamin C, PCM, zinc)

'Flaky paint' dermatitis (PCM)

Desquamation (linoleic acid, biotin)

Dry (vitamin A, linoleic acid)

Rough scaly skin in sun-exposed areas [pellagra] (niacin)

Seborrheic dermatitis (vitamin B_2)

Eczematous scaling around mouth, elbows, knees, genitals, anus (zinc)

Waxy (vitamin B_1, in wet beri beri)

Dermatitis herpetiformis (coeliac)

Erythema nodosum (Crohn disease, ulcerative colitis)

UPPER LIMBS

Palms: crease pallor (anaemias); erythema (CLD)

Nails: leuconychia (CLD); koilonychia (iron); brittle (iron, PCM)

Pulse: bradycardia (iodine, PCM); tachycardia (vitamin B_{12}, hydration)

Wrists: palpable epiphyseal enlargement (vitamin D)

Forearms: tender (vitamin C)

Joints: swollen (vitamin C)

Blood pressure: hypotension (sodium, hydration)

Troussseau's sign (calcium)

HEAD AND NECK

Frontal and parietal prominence (vitamin D)

Increased head circumference (vitamins A, D)

Soft skull [craniotabes] (vitamin D)

Fontanelle
- Large (vitamin D)
- Bulging (vitamin A)
- Depressed (hydration)

Sutures separated (vitamin A)

Hair
- Alopecia (zinc, linoleic acid)
- Dyspigmented (PCM)
- Thinning (PCM)
- Pluckable (PCM)
- Dry (iodine)

Eyes: sunken (hydration)

Lids
- Ptosis (vitamin B_1)
- Blepharitis (vitamin B_2, zinc)

Conjunctivae
- Pallor (anaemias)
- Xerosis (vitamin A)
- Conjunctivitis (vitamin B_2, C)
- Bitot spots (vitamin A)

Scleral icterus (vitamin B_{12}, CLD)

Cornea:
- Xerosis (vitamin A)
- Cloudy (vitamin A)
- Keratomalacia (vitamin A)
- Opacification (vitamin A, zinc)
- Vascularization (vitamin B_2)

Retina
- Optic neuritis (vitamin B_{12})
- Optic atrophy (vitamin B_1)

Eye movements: ophthalmoplegia (vitamin E)

Photophobia (vitamin B_2, zinc)

Facial nerve: percuss for Chvostek's sign (calcium)

Mouth: angular cheilosis and stomatitis (iron, vitamin B_2, niacin)

Teeth
- Caries (fluoride)
- Loose (vitamin C)
- Enamel defects (vitamin D)

Tongue
- Glossitis, reddening and ulceration (vitamin B group)
- Moisture (hydration)
- Cyanosis (CHD, vitamin B)

Buccal mucosa
- Reddened and ulcerated (vitamin B group)
- Petechiae (vitamin C)

Gums: swollen, bleeding (vitamin C)

Contour of lower face
- Prominent salivary glands (vitamin C)
- Pendulous cheeks (PCM)

Neck: goitre (iodine)

GAIT AND BACK

Full gait examination, looking for:
- Cerebellar ataxia (vitamin E, zinc)
- Peripheral neuropathy (vitamins B_1, B_6, B_{12})
- Romberg's sign (vitamins E, B_{12})

Examine back for scoliosis, kyphosis and lordosis (vitamin D)

LOWER LIMBS

Palpate
- Muscle bulk (PCM)
- Ankle oedema (PCM, CLD)
- Long bone tenderness (vitamin C, phosphate)
- Calf tenderness (vitamin B_1, selenium)

Power: decreased (PCM, vitamin C, sodium, potassium, phosphate)

Tone: decreased (PCM)

Reflexes
- Decreased (vitamins B_1, B_6, B_{12}, E)
- Increased (vitamin B_{12}) [note that B_{12} deficiency can cause either]
- Slowed return (iodine)

Sensation
- Peripheral neuropathy (vitamins B_1, B_6, B_{12}, E)
- Posterior column dysfunction (vitamins B_{12}, E)

CHD = congenital heart disease; CLD = chronic liver disease; PCM = protein calorie malnutrition.

Failure to Thrive

This is a very complicated short case and fortunately uncommon. The approach outlined is essentially a nutritional assessment modified to include relevant examination for chronic diseases of the main organ systems. To prevent unnecessary duplication, only aspects not mentioned in the nutritional short case are outlined in detail.

Commence with general inspection for obvious abnormalities, such as recognizable dysmorphic syndromes, central nervous system disease (e.g. cerebral palsy), neuromuscular disease (congenital myopathies, spinal muscular atrophy), tachypnoea (cardiac, respiratory, or renal — metabolic acidosis — in origin), cyanosis (congenital heart disease), and any findings related to nutritional status. Next, request the child's parameters. Failure to thrive as a term is used to describe failure of weight gain in particular, but, particularly if long standing, may include lack of linear growth as well. If the head circumference is significantly affected, this suggests an intrauterine onset.

The percentile charts should be examined; the pattern of the height, weight and head circumference curves relative to each other may well give a valuable indication of the underlying pathology.

1. If all percentiles are equally affected, the possibilities include intrauterine TORCH infections, or chromosomal abnormalities.

2. If height is most affected, possibilities include endocrinopathies and skeletal dysplasias.
3. The common pattern for malnutrition is that the weight is most affected, the height less affected, and the head circumference relatively normal.

Demonstrate fat and protein stores, and then examine the skin fully, in particular for dermatitis herpetiformis (coeliac disease), erythema nodosum (inflammatory bowel disease), pyoderma gangrenosum (inflammatory bowel disease) and note any ichthyosis (Shwachman).

Look next at the hands, noting any clubbing (chronic lung disease, chronic liver disease, inflammatory bowel disease, congenital heart disease), and other nutrition-related signs. Examine the structure of the hands (dysmorphic syndromes), take the radial and femoral pulses (congenital heart disease, coarctation). Check the blood pressure (renal disease, coarctation).

Proceed to the head and neck. As well as nutrition-related signs, look for dysmorphic features, macrocephaly, scars and shunts. In the eyes, look for cataracts or chorioretinitis (TORCH), retinitis pigmentosa (abetalipoproteinaemia, Shwachman syndrome), papilloedema (intracranial tumours, hydrocephalus) and check the extraocular movements (neurological disease). At the mouth, check for thrush (can occur in cell-mediated immunity defects), check the palate for a cleft, note the quality of sucking and test the gag reflex. If a bottle or breast is available, the method of feeding should be observed.

Now, move to examination of the chest. Look for sternal deformity (syndromes), hyperinflation, Harrison's sulcus, use of accessory muscles, intercostal recession (chronic lung disease), scars of cardiac or pulmonary surgery. Palpate tracheal position, apex beat, praecordium for thrills and heaves, percuss the chest and auscultate heart and lungs thoroughly, to assess for chronic respiratory or cardiac disease.

Then, move on to the abdomen. Perform a full abdominal examination (see page 104). The findings sought include abdominal distension (ascites with chronic liver disease, coeliac disease, protein calorie malnutrition), prominent veins (chronic liver disease), scars of previous surgery (e.g. bowel resection with necrotizing enterocolitis, Kasai procedure for biliary atresia), hepatosplenomegaly (chronic liver disease, TORCH, metabolic and haematological diseases), enlarged kidneys (polycystic kidneys, hydronephrosis), anal anomalies (syndromes), rectal prolapse (cystic fibrosis), excoriated buttocks (carbohydrate intolerance).

Next, stand the child, walk him or her, checking the gait for primary neurological disease, as well as nutritional deficiencies. Examine the back for midline defects or skeletal abnormalities such as kyphoscoliosis (syndromes, cerebral palsy) and then return the child to the bed and examine the lower limbs, again predominantly to detect primary neurological disease, as well as nutritional parameters. Note that if the patient is an infant, a gross motor developmental assessment is more appropriate at this point, and this may be combined with checking the primitive reflexes.

Request the urinalysis for specific gravity (low with chronic renal failure, diabetes insipidus), glucose (diabetes), pH (renal tubular acidosis), protein (structural kidney disease, proximal tubular disease), blood (structural kidney disease, urinary tract infection), nitrites (urinary tract infection), and bilirubin (chronic liver disease). Also, request stool analysis, for evidence of steatorrhoea,