

Complementary feeding and HIV

1 day module

Session 1

Recommendations on nutrient intakes

Energy

Sources of energy:

- fat is the principal source for infants under 6 months of age, approximately 50%
- carbohydrate – its role as an energy source increases with the introduction of complementary food
- protein

Energy requirement from BM and complementary foods in kcal

| Age (months) | Industrialised countries | |
|--------------|--------------------------|----------------------------|
| | Breast-milk (kcal) | Complementary foods (kcal) |
| 0-2 | 490 | 0 |
| 3-5 | 548 | 2 |
| 6-8 | 486 | 196 |
| 9-11 | 375 | 455 |
| 12-23 | 313 | 779 |

Energy needs of children with HIV

- HIV+ symptomatic, experiencing weight loss: if possible, increase energy intake
by **50 – 100%**

Minimum daily number of meals for children with low level of BM

| Energy density (kcal/g) | 6 – 8 months | 9 – 11 months | 12 – 23 months |
|------------------------------------|-------------------------|--------------------------|---------------------------|
| 0.6 | 3.7 | 4.1 | 5.0 |
| 0.8 | 2.8 | 3.1 | 3.7 |
| 1.0 | 2.2 | 2.5 | 3.0 |

Problems with soups and porridges

Thin porridge made from staples alone :

- is watery,
 - has a low energy concentration (density),
 - and also low nutrient density.
-
- Although soups may contain nutritious foods, they are dilute and watery – they fill children's stomach, but do not meet nutritional needs.

How to increase energy density

- cook with less water and make thicker porridge
- replace some water with milk
- add extra nutrients and energy – e.g. add milk powder and sugar (or butter or margarine)
- take out a mixture of solid pieces (e.g. beans, meat, vegetables, staples) a mash to a thick puree. Soften with little oil, butter or margarine

Energy requirements of infants and young children

- Energy requirements of infants and young children per kilogram body weight are 2-3 times those of adults: the energy density of complementary foods is the key factor determining energy intake.
- Factors affecting the energy density of complementary foods:
 - fat (+)
 - sugar (+)
 - breast-milk (+)
 - meal frequency (+)
 - water (-)
 - viscosity of complementary foods (-)

Gastric capacity in ml (30 ml/ kg body weight)

| | | |
|---------------------|----------------------|-----------------------|
| Age 6 – 8 months | Age 9 – 11 months | Age 12 – 23 months |
| 250 ml | 285 ml | 345 ml |

Proteins

- Recommended values of proteins were extremely high in former SU, almost twice as high per kg body weight than e.g. in USA.
- Note! Infants and young children in former Soviet Union were quite never deficient in proteins.

Fat

Sources

- "visible" fats – cooking oils, butter, vegetable oils (olive, sunflower, maize, and others), fat on meats
- "invisible" fats – added to foods during preparation and cooking and in the process of food production (mayonnaise, sausages, etc.)
- Most infant formulas do not contain one of the fatty acids essential for the developing brain (docosahexaenoic acid).

Balance of fat intake

- During the introduction of complementary foods and up to at least 2 years of age, it is recommended that fats be included in the diet providing for 30-40% of the total energy intake.
- Too little fat: possible decrease in energy intake.
- Too much fat: possible decrease in micronutrient density.

Carbohydrates

- Consumption of added sugar should be limited to a level providing up to 10% of the total energy content of the diet.
- A high intake may worsen the vitamin and mineral status.
- Sugars are present also in soft drinks in large amounts, in “kompots” and “varenie” as well.

Vitamin A

- Vitamin A is obtained from animal products as provitamin retinol,
- or is converted from carotenes, in particular, α -, β - and γ - carotenes found in vegetable food.
- There are high levels of retinol in liver, milk products, eggs and fish.
- Dark-green leafy vegetables and yellow and/or orange fruit and vegetables (carrots, pumpkin, apricots) are rich sources of carotenes.

Deficit and toxic effect of vitamin A

- A moderate decrease in the level of vitamin A in the body without clinical signs is associated with reduced resistance to infection.
- Moreover, vitamin A deficiency contributes to the development of anaemia.
- The toxic effect including bone and liver damage, may result from high doses of retinol, especially when vitamin A supplements are administered for a long period of time.

Sources of vitamin D

- The body obtains vitamin D primarily through synthesis in the skin exposed to the ultraviolet B radiation from sunlight.
- Foods rich in vitamin D include fatty fish (sardines, salmon, herring, tuna), some of the milk products (including infant formulas), eggs, beef and liver.

Deficit of vitamin D

- The vitamin D status of newborns largely depends on the mother's status. If the stores and intake of vitamin D of the pregnant woman were low, then the newly born baby will also have a low concentration in the plasma and a low store of this vitamin.
- The content of vitamin D in complementary foods is usually low, therefore, exposure to sunlight is important for infants and children under 3 years of age.
- Children with most of the skin protected from the sunlight with clothes, dark-skinned children, those living in northern latitudes and vegetarians are vulnerable to the risk of developing vitamin D deficiency.
- Vitamin D deficiency results in rickets in children and osteomalacia in adults.

Vitamin C

- Vitamin C is required for the optimal functioning of the immune system, for the processes of haemopoiesis, collagen synthesis, it has an antioxidant effect, stimulates absorption of non-haem iron and facilitates transport of iron to tissues by release from transferrin.
- Vegetables and fruit, berries, especially spinach, tomatoes, potatoes, cabbage, currants, dog rose fruit, citrus fruits are good sources of vitamin C. Small amounts of vitamin C are present in animal products (liver, brain, muscles).
- The vitamin is labile, a considerable proportion of it is destroyed by cooking and prolonged storage.

Iodine

- Inadequate iodine intake results in impaired synthesis of thyroid hormones that are required for normal growth and mental development of the infant, oxygenation of cells and maintenance of basic metabolism.
- The content of iodine in animal and vegetable products depends on the environment in which these are grown. Sea fish and sea foods are rich natural sources of iodine (160-1400 $\mu\text{g}/\text{kg}$). About 200 g of sea fish per week can meet the requirements of young children for this trace element (50 $\mu\text{g}/\text{day}$).

Iodine fortification

- Iodized salt may be a source of iodine, where natural sources are not available.

But:

- Note! Young children, especially in the first 4 months of life, have a limited ability of their renal-excretory system to control excessive sodium. Therefore, salt intake should be low, and there is no need to add salt during cooking for young children.

Specific needs of children living with HIV

- deficit of B6, B12 is associated with faster progression to the stage of AIDS
- normal level of B12 (>120 pmol/l) would delay the progression to AIDS with 4 years
- increase of vitamin E (>23 umol/l) delays with 1.5 year
- deficit of vitamin A, D and zinc is associated with faster progression to AIDS

Session 2: Nutrition-related health problems

Lecture 5

Control of iron deficiency in children

Iron deficiency anaemia in children

leads to

- increased prenatal and perinatal mortality;
- lowered physical activity;
- faltering growth and mental development of children;
- increased susceptibility of children to infection.
- Symptoms of anaemia may be nonspecific conditions, such as fatigue, weakness, dizziness and increased sensitivity to cold. Chronic anaemia manifests itself in changes to the fingernails, hair or tongue, breathlessness and heart failure.

Classification of anaemia by the level of haemoglobin in peripheral blood

- Haemoglobin (g/dl): severe < 7 g/dl , moderate < 10 g/dl (in children aged between 6 months and 5 years) and < 9 g/dl (in children less than 6 months), mild 10–11g/dl
- It is recommended that young children be given 12.5 mg of iron and 50 μ g of folic acid per day, starting from 6 months of age, or, in the case of low-birth-weight or premature babies, from 2 months. Overall duration of treatment should be up to 24months.

Iron content (mg/100 mg) and absorption (%):

- breast-milk – 0.08 mg (50%);
- cow's milk – 0.06 mg (10%);
- infant formula – 0.8 mg (20%);
- porridge – 0,4 mg (5%);
- mashed vegetables, fruit– 1.0 mg (5%);
- meat – 0.5 – 1.6 mg (23%);
- liver: haem – 2.4 mg (23%),
non-haem – 1.6 (10%);
- beef: haem – 1.2 mg (23%),
non-haem – 1.8 (10%).

Iron content in some foods, and percentage of their absorption

- Rice/porridges 5%
- Rice/beans 5%
- Rice+beans +fruit 10%
- Rice+fish/meat/liver 10%
- Rice+fish/liver/meat+vegetables 15%

Session 2: Nutrition-related health problems

Lecture 6

Factors influencing children's food choice

Session 3

Complementary feeding

Complementary feeding - introduction

After the first six months,

infants in their first year of life need complementary food to be given them along with breast-milk.

Timely introduction of complementary food

- promotes good health,
- physical growth,
- and prevents growth retardation
in children above 6 months of age.

Definition of complementary f.

The period of complementary feeding is the time when the infant is given:

- foods and liquids other than breast-milk,
- while breastfeeding continues.

It is during this period that severe malnutrition usually occurs, the consequences of which show themselves throughout the whole life.

Introduction of complementary f.- I.

Starting to early:

- If breast-milk is displaced, it will lead to reduced production of breast-milk;
- the risk of diarrhoea and allergic disease will increase due to intestinal immaturity;
- infants become exposed to microbial pathogens that may be present in food or water, which increases the risk of disease;
- traditionally, thin porridges or soups are often given as complementary foods, and these have a lower energy and nutrient density ;
- mothers become fertile sooner.

Introduction of complementary f.- II.

- **Starting too late (later than the end of the sixth month)**
- retardation or lack of growth resulting from inadequate energy and nutrient intake with breast milk;
- increased occurrence of diarrhoea and respiratory disease due to nutritional imbalance caused by inadequate nutrient intake;
- increase in micronutrient deficiency disorders because the intake of micronutrients does not meet the requirements of the growing body.

Basic rules of successful complementary feeding

- Choose the most appropriate time for giving complementary food during the day,
- when the infant is most disposed or hungry,
- and the mother can give more time to her baby.
- The time before noon is to be preferred.

Basic rules II.

- Any complementary food should be introduced slowly, starting with a teaspoon and gradually increasing to full volume.
- Initially, it should be a homogeneous, medium-consistency single-ingredient puree made of some of the more typical products in the area, such as rice porridge or mashed potatoes.
- To facilitate and expedite the infant's getting accustomed to new foods, it is recommended that expressed breast-milk be added to the complementary food being introduced. In order to prevent reduction in breast-milk production, a complementary food may be introduced after breastfeeding.

Basic rules III.

- 5-6 days after the first complementary food has been introduced, a 2nd one is added,
- then, in another 5-6 days, a 3rd one.
- The variety of foods used in infant's diet should be increased during this time, adding various multi-ingredient dishes, such as:

meat + vegetables, meat + vegetables* + cereals, vegetables* + cereals, vegetables* + fruit + cereals, etc.

* *Including legumes: beans, peas, lentils*

Quality of complementary food

Each time the infant takes complementary food, the meal should be adequate in terms of its

- energy

(ensured by giving food which has the volume and consistency that is appropriate for the infant's age)

- nutrient value.

(variety of foods used)

Energy density of complementary foods

- The energy density should be, on the average, **at least 1 kcal per gram**, depends on the frequency of feeding.
- A lower calorific value is allowed only with an increased frequency of feeding.

Practical instruction

- Complementary food should be sufficiently thick, but allow feeding the infant with a spoon.
- To achieve an acceptable consistency, some of the water can be replaced with breast-milk or artificial milk formula.
- Thick porridge should be enriched with vegetable oil or butter (to increase the calorific value), egg, meat, fish, legumes, nuts (sources of high-quality protein).
- If water is used, it should be the same water in which vegetables, fruit or meat were boiled.

Nutritional adequacy

- Animal food: 100 kilocalories would normally contain adequate amount of such nutrients as retinol, vitamins D and E, riboflavin, vitamin B12, calcium and zinc.
- Vegetable food: In contrast, the levels of thiamin, vitamin B6, folic acid and ascorbic acid are usually higher than in animal food.
- Therefore, variety of foods should be given for complementary feeding.

Gluten-free cereals

When choosing cereals, one should better start with gluten-free ones, such as:

- rice
- buckwheat
- maize

Gluten is contained in wheat, semolina, barley, pearl-barley, oatmeal.

Meat

Meat is an essential product for infant nutrition in the first year of life, and a valuable source of iron to prevent anaemia.

Meat is introduced in the infant's diet from six months of age.

- First it should be in the form of puree (boiled meat minced twice),
- then meat minced once,
- and later cut into small pieces.

Types of meat

Lean meats are recommended for infant feeding, such as:

- beef
- mutton
- horse-meat
- poultry (chicken, turkey)
- rabbit.

Poultry should be skinned, other meats should be cleared of tendons and fasciae.

Milk

- Whole unmodified cow's milk is not recommended as a drink until the age of 9 months, (only allowed to be used to cook porridges when diluted by half or less).
- If fermented milk products are introduced as a drink to the diet of a 6-9-months old infant, these should be diluted with boiled water in a one-to-one proportion.
- After 9 months of age, whole milk and milk products are recommended, not low-fat or diluted ones.

Fruit and vegetable

- Vegetables and fruit should be locally produced.
- Juices and fruit-and-vegetable purees are better when they are home-made, rather than produced commercially.
- When no fresh vegetables or fruit are available, then use their preserved, frozen or dried analogies. (Note! Safety rules must be carefully observed in preparing.)
- No large amounts of salt and sugar should be used.

Ingredients

- There is no need to use salt, sugar or spices when cooking meals for children under 3 years of age. Where family food is used to feed the child, it is necessary to put aside the portion to be given to the child before salt, sugar or spices are added.
- Recommended types of cooking include boiling, stewing and frying without oil, grilling, cooking in a microwave oven or bakeoven.

Session 4

Growth assessment

Growth

Growth is an increase in the mass and dimensions of the body, comprising:

- weight (kg)
- length or height (cm)
- **During the first 6 months of life, infants grow faster** than at any other time after birth, gaining, on the average, 200 g in weight and almost 1 cm in length per week.

Vulnerability

- **Infants and young children are very vulnerable** to growth faltering and loss of body mass as a result of malnutrition.
- Retardation of the growth is usually permanent and cannot be solved in future.

The expected growth during the first 2 years of life

Average growth of the body mass, length and head circumference

| Parameters | Age (months) | | | | |
|--------------------------------|---------------------|-------|-------|--------|---------|
| | 0 – 3 | 3 – 6 | 6 – 4 | 9 - 12 | 12 – 24 |
| Body mass (kg) | 2.5 | 1.8 | 1.4 | 0,9 | 2,5 |
| Length (cm) | 10 | 7 | 5 | 4 | 10 |
| Head circumference (cm) | 5,4 | 3,0 | 1,8 | 1.4 | 2,2 |

Time of measurement

- at birth
- every month (for the first 3 months)
- every 3 months (6, 9, 12 months)
- every 6 months after 1 year

Body length and height

- **Before 2 years of age,** the body length has to be measured in lying position, as measurement using a stadiometer is either impossible or inaccurate. At the age of 2 years and after, the height is measured in standing position using a stadiometer.
- To ensure accurate and reliable measurements, it is extremely important **to use standardised techniques and calibrated equipment.**

Weight for height (length)

- **Low weight for height** (wasting - undernutrition) is the result of either failure to gain weight or weight loss.
- **Criteria:** < -2 SD (standard deviations) of the median weight for a given height
- Indicates severe undernutrition
- Can develop rapidly
- Can be reversed rapidly
- **Excessive body mass (fatness)**
- **Criteria:** average weight $> + 2$ SD
- Fatness in infancy does not associate with obesity in later life

Height for age

- Low height for age is the result of a retardation of the skeletal system development.
- **Criteria:** < -2 SD of the median height for a given age
- Reflects **chronic** undernutrition
- Causes of early onset of stunting:
 - poor nutrition (complementary feeding)
 - premature birth
 - retardation of intrauterine development
 - infections
 - poor infant-mother interaction
- **early stunting increases the risk of** mortality, delayed motor development, impairment of cognitive function and school performance, impairment of glucose tolerance in adult life.

Stunting

Early stunting increases the risk of

- mortality,
- delayed motor development,
- impairment of cognitive function and school performance,
- impairment of glucose tolerance in adult life.

Growth chart

- to be scanned

Weight for age

- this indicator encompasses both weight for height and height for age
- **criteria:** $< -2\text{SD}$ of the median weight for a given age

Often observed are:

- low weight for age
- low height for age
- normal weight for height
- In younger children: the low weight for age is a reflection of a low weight for height.
- In older age groups: Low weight for age is associated with a low height for age.

Session 5

Dietary assessment in children

24-h recall in children

- **Recall:** usually 24 h, sometimes 3 days
 - Weight
 - Estimated (Photo book, 3D models)

Strengths: easy, quick, cheap, useful in large samples

Weaknesses: less representative, rely on memory, requires kitchen/serving literacy, not possible in children < 7 yrs

Limits of 24-h recall in children

- Age (not useful under 7 years of age: caretaker should be interviewed instead of the child)
- In small infants and children, caretakers often are multiple and none of them is 100% informed about child's daily diet in total
- Language (always mother tongue of the interviewed)
- Relies very much on memory and the compliance
- Not always representative
- Needs metric/kitchen literacy (basic idea about the portion size and servings)

Food frequency questionnaire in children

- Semi-quantitative
- Quantitative

Strengths:

Covers long period, not influenced by short term changes

Weaknesses: reflects more people's desire than reality, less exact, not possible in children < 7 yrs

Usual intake recall in children

- Applicable only in caretakers, not in children under 7 years or even older.

Strengths: quick, cheap method, does not reflect changes and extraordinary situations

Weakness: less exact, affected by socially desirable image,

Not possible in children < 7 yrs.

WHO 10 points score – applicable from 5 years of age:

(answer “yes” is achieving 1 point, “no” 0 points)

1. Have you eaten at least 6 servings of cereals, pasta, bread or rice?
2. Have you eaten at least 3 servings of vegetable?
3. Among them, were at least 2 servings of fresh vegetables?
4. Have you eaten at least 2 servings of fruits?
5. At least 1 serving of fresh fruit?
6. Did each food group contain variety of food items?
7. Have snacks and foods consumed between main meals any nutritious value except energy?
8. Have you eaten at least 2 servings of milk or dairy products?
9. Have you eaten at least 2 servings from the food group of poultry, fish, meat, pulses?
10. Mostly lean or low fat product were chosen?

Session 6

Nutrition during Emergencies

Support for breastfeeding women

- In populations where the habitual practice in infant feeding was to use breastmilk substitute, and where processed commercial products were given as weaning foods to young children, it might be necessary to support mothers in adopting new techniques during the emergency.
- Important: to promote and support breastfeeding. In this sense, the emergency can sometimes provide an opportunity to change practices which pose health risks. (However, an emergency is rarely the right time to encourage behavioural change which is not an absolute necessity.)

Powdered milk

- Powdered or modified milks that have not been mixed with other commodities **should not be included in a general food distribution** because their indiscriminate use could result in serious problems.
- Of particular concern are the potential health hazards that are likely to occur as a consequence of inappropriate dilution, germ contamination or lactose intolerance and also replacing BF.

Food acceptability

Key indicators

- People are consulted on the acceptability and appropriateness of the foods being distributed and results are fed into programme decisions.
- Foods distributed do not conflict with the religious or cultural traditions of the recipient or host populations (this includes any food taboos for pregnant or breastfeeding women).
- The staple food distributed is familiar to the population.
- Complementary foods for young children are palatable and digestible.
- !!! There is no distribution of free or subsidised milk powder to the general population !!!
- People have access to culturally important condiments (such as sugar or chilli).

Clinical features of starvation

- Thin
- Dry skin
- Wasted muscles
- Hair without lustre
- Slow pulse
- Reduced blood pressure
- Amenorrhoea
- Impotence
- Spontaneous abortion, miscarriage
- Oedema (“famine” oedema)
- Anaemia
- Diarrhoea (in weakened children prolapse of the rectum)
- Psychological and mental disturbances (lost of concentration)
- Intracable diarrhoea => vascular collapse, heart failure => death

Additional guidelines for food relief

- Ensure, that adequate fuel and cooking utensils are available
- Foods distributed weekly if possible, or every 2 weeks
- Bottle-feeding or breast milk substitutes are strongly discouraged, breastfeeding encouraged
- Dried skimmed milk should be mixed with the cereal if possible to prevent using it for bottle feeding
- Providing vitamin A and C, when fruits and vegetables are not available (fortification, and if necessary, medical supplementation)
- To add to the rations items that are valued by the society, and enhance palatability (to prevent purchasing of energy sources to earn money)

Additional guidelines for food relief

II. – cont.

- Sometimes the supplement of 300 – 500 kcal (in energy-dense form) to in risk-groups can prevent serious malnutrition
- High standard of food hygiene must be maintained
- Possibility to use mobile kitchens or mobile canteens
- Prices can be controlled by the government (especially the staple one)
- Estimating food needs in various ways can be useful
- System of weekly reporting is highly desirable

Principles of the ration

- Same ration given to each person irrespective to age: 1900 kcal

Recommendation:

- Protein 8 – 12% of the energy
- Fat at least 10 % of the energy

Usual demographic distribution in affected populations

| Age group (years) | < 5 | 5 – 14 | Females 15 – 44 | Males 15 – 44 | Both sexes >44 |
|----------------------|-----|--------|---|------------------|-------------------|
| Distribution (in %) | 20 | 35 | 20 (40% of them pregnant + breastfeeding) | 10 | 15 |

Examples of the daily ration

| Quantity (g) / Food item | Ration 1 (g) | Ration 2 (g) | Ration 3 (g) |
|---------------------------------|-----------------|-----------------|-----------------|
| Wheat flour / maize meal / rice | 400 | 400 | 400 |
| Pulses | 60 | 20 | 40 |
| Oils / fats | 25 | 25 | 25 |
| Fortified cereal blend | 0 | 30 | 0 |
| Canned fish / meat | 0 | 0 | 20 |
| Sugar | 15 | 20 | 20 |
| Salt | 5 | 5 | 5 |

Food-for-work

In non-famine situation food is provided only in exchange for work (used by WFP).

- Advantages: helps prevent the recipients from acquiring the mentality of assisted people
- Disadvantages: hard work increases energy needs

Note! If free food is badly planned, sometimes those who cannot work, i.e. children, elderly, pregnant women may not receive the food.

Monitoring of the public health

- Level of sanitation
- Potable water
- Personal hygiene
- Safe feeding

Nutrition in refugee camps and settlements

Sometimes food provided may have provided sufficient energy, but did not nearly meet the nutritional requirements for certain essential nutrients (scurvy, beri-beri, pellagra, vitamin A deficiency, iron deficiency anaemia...).

Basic essentials

- Adequate food to satisfy both energy needs (and perhaps wants) and micronutrients, provided in acceptable forms
- Water of adequate quality and sufficient quantity
- Latrines that help prevent the spread of diseases caused by faecal contamination
- Shelter-tents, temporary structures or existing buildings such as schools or churches, that ensures protection from the weather (heat, cold, rain etc.), that is secure, safe and vermin free, or at least does not promote the spread of disease
- Health services that provide a reasonable level of primary health care
- Safety from human depredation and other dangers
- Socially and psychologically stimulating environment, where cultural and religious beliefs and practices are respected

Vitamin A deficiency

- Supplements should be given where risk is present (refugees from risk areas, with signs of deficiency, or where rations provide less than 2500 IU (750 RE) per day.

Recommendation: high doses orally

- 400 000 IU (120 000 RE) for all children 1 – 5 years
- 200 000 IU (60 000 RE) for infants 6 – 12 months
- 200 000 IU (60 000 RE) for lactating mothers

Clinical examination

- Name, surname _____
- Pregnant: _____
- Lactating: _____
- Haemoglobin _____
- Haematocrit _____
- Height _____
- Circumference of the middle part of the left arm _____
- Skin folder above the triceps _____

Clinical examination - Hair

- Lack of natural shine, lack of luster, shedding of hair
- Depigmentation or change of colour of the hair
- Change of the hair structure (dryness, thinning, brittleness, shedding)

Clinical examination - Oral cavity

- Angular stomatitis
- Cracking (cheilosis) of the lip corners
- Loose or bleeding gums
- Atrophic glossitis
- Spottiness of teeth
- Delayed eruption
- The number of decayed (D) teeth
- The number of missing (M) teeth
- The number of filled (F) teeth
- Total DMF

Clinical examination – cont.

Skin

- High keratinisation, dryness of the skin.
- Follicular hyperkeratosis
- Pellagric dermatitis
- Skin hemorrhages (petechia, punctate hemorrhage)
- Oedema
- Ulcera
- Desquamative dermatosis

Finger nails

- Paleness of nailbed
- Change in the shine, surface

Glands

- Enlarged thyroid (goiter, degree of enlargement - 0, I, II, III)

Clinical examination – cont. II.

Face

- Moon-like
- Pale
- Moles, pigmentation of eyelids

Eyes

- Dusk or night blindness
- Cornea: dryness, inflammation, keratoleukoma, Bitot macula, malacia, ulcera
- Vascularisation or hyperemia of the conjunctiva
- Pale palpebral conjunctiva
- Photophobia
- Keratitis – inflammation and intensive vascularisation of the cornea

Clinical examination – cont. III.

Muscles

- Muscle hypotrophy
- Pains in the musculus gastrocnemius

Skeletal system

- Epiphysis of bones – enlargement
- Thickening in the places where the rib bone and cartilage join – beading
- Deformity of the skeleton
- Deformity of the lower limbs
- Delayed closure of the fontanel
- Growth retardation or cessation

Clinical examination – cont. IV.

Central nervous system

- Apathy, depression
- Weakness, fatiguability
- Loss of sensitivity
- Restriction of joints (knee, elbow joints)
- Motor weakness
- Weakness of the musculus gastrocnemius

Internal organs

- Hepatology
- Splenauxe