


Nutrition

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This presentation is about nutrition. It is placed here in the course, after tuberculosis, because nutrition is so very important in the treatment of TB. Be sure you are sitting with your group and that you have a hand calculator with you. There was a handout with the physical exam lecture, correlating tooth eruption with the age of the patient. It is helpful to have that on hand for this lecture also.



Overview of nutritional evaluation

- Evaluate the patient.
- Evaluate his diet.
- Now it's your turn.

Western medical education does not adequately address the nutritional needs of patients. There is good reason for this: most patients in the West are overfed. Those who are malnourished usually are this way because of their own choices. Moreover, there are dieticians galore in the West; a simple referral solves a patient's nutritional problems. Physicians don't have to deal with them. It is not this way in Timbuktu.

Nutrition is a vital part of any treatment plan.



Art Explosion

In the States, poor people tend to be overweight. They can't afford Jenny Craig or a weight-watcher's diet. Given a robust welfare system, strenuous physical labor is not essential to survival. Food stamps provide plenty of high-calorie junk foods. Stateside welfare malnutrition is a problem, but it is not your concern. Your concern is about malnutrition in your own Timbuktu. That is entirely different.

In Timbuktu, poor people are invariably emaciated. The presence or absence of body fat correlates very closely with family income; the fatter the richer. It is the ambition of most teenagers to be fat. Fat means survival over the next famine; it is life insurance, security for the future. Junk foods are not available. Hence, normal or excessive body weight necessarily means adequate nutrition; nutritional intervention and support are not necessary. You need only concern yourself with nutritional support of those underweight and those eating grossly unbalanced diets.

How can you evaluate your patient's nutritional condition?

Body Weight

Arm Circumference

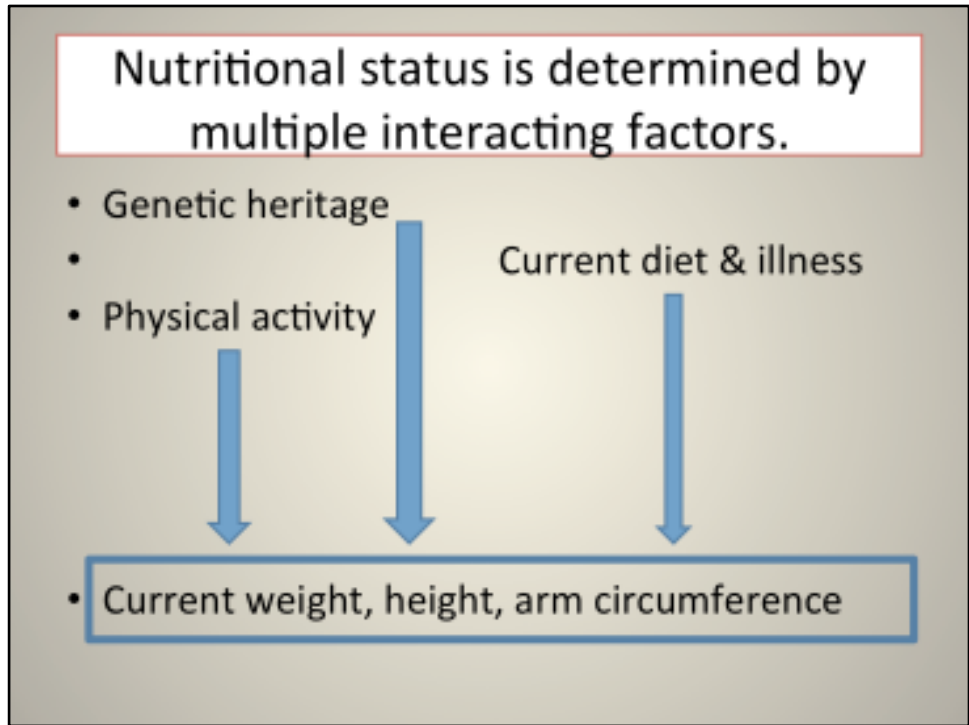


There are three systems for evaluating a patient's general nutrition: Weight for age, weight for height, and arm circumference.

Weight for age is not very useful since, in developing countries, most people don't know their ages. There are ways to guess a child's age until puberty but these are not very accurate. Also, weight for age varies greatly with the patient's genetic heritage. It is necessary to create locally applicable standards which takes time, as in scores of hours, over months.

Weight for height is generally useful. It is most useful when incorporated into the formula for BMI, body mass index.

Arm circumference is most useful as a screening tool to determine which child to admit to a feeding program. It is better than the BMI or weight for age in that it predicts death from malnutrition with more accuracy. It involves knowing the patient's general age range, which can be determined by physical examination. An accurate age is not necessary. Arm circumference, however, is useless as a way of monitoring progress; it changes very slowly with refeeding.



A patient's genetic heritage, diet, current illness, and customary physical activity all interact to determine his body measurements. In someone whom you are seeing for the first time, it is difficult to sort out these factors. In Western countries a patient's medical records document his previous heights and weights—a very helpful tool for evaluating his present condition. In Timbuktu, even a Road-To-Health card is unusual. The possible explanations for a child's current condition are legion. Moreover, when impoverished patients sense there is free food on the horizon, they will tell a missionary whatever lies they deem necessary. Ages are commonly inflated so a normal 4 year old is passed off as a malnourished 7 year old. Unless you can verify age by looking at teeth, the result can be a confusing mess.

You need a simple system that is applicable wherever you are.



In the context of Timbuktu, sophisticated lab and high-tech electronic devices are out of the question. Even scales are problematic; they are expensive, and their longevity is limited as they are transported over rough roads. They are heavy and bulky. Children object to being placed in hanging scales, upsetting their mothers. Height is a problematic measurement in infants since they need to lie on a hard surface with head and feet extended. It frequently takes 3 people to measure an infant's height; the end result is a screaming child and an unhappy mother. Nevertheless, scales and rulers are useful tools and in some circumstances, essential.

A much simpler system involves only a tape measure and a 3 x5 card with normals. It's the mid-upper-arm circumference, measured half-way between the elbow and the shoulder. It predicts a child's risk of dying with greater accuracy than weight for height or weight for age. Use it to admit children to a feeding program but then follow their progress with sequential weights.

History, physical examination, and nutritional support are your tools.




History in this context is nutritionally directed. It entails knowing the culture, its foods, and its food preparation customs. It entails knowing the patient's medical history to the extent that you can anticipate special needs for growth or for recovery from illness or injury.

Physical examination in this context means nutritionally-directed body measurements and observations. Mid-upper arm circumference is basic; it tells you whether or not you need deal with a specific patient. An age estimate is likewise basic, because it is the basis for interpreting the MUAC. Height and weight enable you to calculate the body mass index, a universally-applicable number indicating nutritional need or lack thereof.

Specific nutritional deficiencies may be evaluated by observing skin and skin structures, eyes, lips, and legs.

- Overview of nutritional evaluation

 **Evaluate the patient.**

- Evaluate his diet.
- Now it's your turn.

First you need to look at your patient and the cultural context in which he lives.

Evaluate your patient's nutritional state.



Evaluating your patient's nutritional state involves determining his weight, height, age, and arm circumference. Get a general idea of his caloric intake, the adequacy of his protein consumption, and whether he has any vitamin deficiencies.

Determine MUAC and age.



The tape measure is put around the arm, midway between the elbow and shoulder. It is pulled tight, but not enough to pucker the skin. The circumference is read in centimeters. The normal range for the particular patient is determined by his age. This young fellow is about 11 years old, judging by his teeth.

By age 3 there are 20 teeth



Parents usually know a child's age in months for the first year or two. However, it is important to check on the reported age for truthfulness. The following guidelines are reliable unless the patient is HIV positive or has congenital syphilis or rickets. In these cases there is delayed teething so the child will, in fact, be older than what his teeth indicate.

The first tooth erupts, usually, between 5 and 7 months. By 12 months a baby has 6 teeth. By 18 months he will have 12-14 teeth. Between ages 3 and 5 years he will have a mouth full of baby teeth.

A child age 6 can touch his ear.



A baby's head is very large relative to the rest of his body. With growth and development, the trunk and limbs become proportionately larger. By age 6 a child's arm is long enough that he can put it up and touch his ear on the other side of his head. This is about the same age when he starts losing his front baby teeth. The Ethiopian government uses this as the criterion for allowing children to start public school.

A child age 8 has 4 adult teeth



Upper baby teeth are usually square or else a bit wider than long. If you look into the mouth of a child who has both adult and baby teeth, the difference is very evident. The first adult teeth to erupt are the four front teeth. A child is at least 8 years old if he has 4 adult teeth in front. After that the adult teeth erupt quickly. At 9 years the canine teeth start coming. By 10 years a youngster has 12 adult teeth.

Determine height and weight.



The mid upper arm circumference is much better than height and weight to determine if a child needs nutritional support. However, you also need to determine height and weight under four circumstances:

1. You are nutritionally supporting someone and want to follow his progress. The MUAC is useless for this; you need to follow his body mass index which will reflect early changes in his nutrition.
2. If a child has rickets or if he is HIV positive, you cannot determine his age with any accuracy. In this case the BMI, necessitating height and weight, are essential.
3. The patient is a physically active adult who does a lot of work with his biceps. He may be malnourished and yet have a normal or nearly-normal MUAC. However, his BMI will reflect his malnourished state.
4. With some ethnic groups, malnutrition results in stunting, a shorter height but a normal weight for height. Hence, a child might be malnourished and still have a normal BMI. If you suspect this is the case with your ethnic group, then you should use weight for age rather than BMI. As you refeed a stunted child, his height will increase dramatically. His BMI might even fall temporarily before increasing.

Measure weight with a kilogram scale.



If you buy a kilogram scale overseas and learn to think in kilograms rather than pounds, it will save you doing the math conversions necessary to calculate the BMI. Floor scales are notoriously inaccurate, and they do not gladly tolerate jouncing over 4-wheel-drive terrain. Therefore, check them against a known weight every once in a while and adjust accordingly. The author's scale reads low by 10%; knowing this it is easy to arrive at the true weight from the given weight.

Calculate the BMI

$$\text{BMI} = \frac{\text{Kilograms} \times 100}{[\text{height in cm}]^2}$$



The BMI is the weight in kilograms times 100, divided by the height in centimeters, squared. A normal BMI is about .2 to .25. Below .19 the BMI is marginal; in cases of severe malnutrition, the BMI might be as low as .11. A BMI over .3 indicates obesity.

This young fellow was diagnosed with abdominal tuberculosis. His height was 142 cm and his weight 28 kg. That gave him a BMI of .138 which is definitely in the malnourished range. His arm circumference was 16 cm, definitely lower than normal for his 11 years of age.

Sometimes the BMI is not helpful.



If the patient is pregnant or has a distended abdomen or swollen legs, his BMI will be falsely elevated. He will seem to be well nourished when, in fact, he is not. If you note swelling anywhere, regardless of the cause, use the arm circumference rather than the BMI to determine whether he is malnourished. Don't trust the BMI number.

Determine specific deficiencies.



Nutritional deficiencies are reflected in the physical examination. Specifically, one should focus on the skin, head, and legs.

Hair and skin changes with malnutrition.



This boy's genetic heritage is sub-Saharan African. He should have black, curly hair, but his hair is straight and blond. If you grasp a hair and pull it out, it comes out easily and the process does not hurt him at all. His skin is a much lighter color than it should be. He is severely malnourished. During World War 2, it was discovered, in Holland, that blond hair turns dark in the presence of malnutrition; genetically fair skin turns dark. In contrast, genetically dark hair turns blond, and genetically dark skin turns fair in the presence of malnutrition.

The little girl is totally bald. She was so critically malnourished that she lost all her hair; she was much worse than the boy.

Skin and lips become rough.



The skin of the boy on the left is dark and rough. He complains of abdominal pains with eating. The man on the right has sore, cracked lips, unresponsive to lip balm. If you look carefully you can see that his skin is also darkened and rough, sparing the area right under his eyes which is normal skin. These two patients both had a deficiency of the B vitamins. They responded readily to Vitamin B complex. However, their problems will recur if they do not abandon their corn-only diet.

There is abnormal bleeding.



Scurvy causes abnormal bleeding: tiny black and blue marks arise spontaneously on the skin. This is particularly common on the lower legs and ankles. The gums may swell and bleed, loosening the teeth so that they fall out.

Eyes deteriorate.



CDC Public Health Image Library

Vitamin A is a yellow-orange color. It is found in all foods that have those natural colors: carrots, papayas, mangoes, egg yolks, pumpkins, and particularly red palm oil. Night blindness develops with vitamin A deficiency. The first evidence of this is little bits of white foam, like meringue or soap suds, on the lower lids. This is what you see in the picture on the right. As the problem progresses, the whites of the eyes become wrinkled as you see in the picture on the left. Given yet more time, the entire eyeball collapses, becoming blind. Strangely enough, the problem is not always symmetrical on the two sides. Once the process starts, treatment is very urgent. An hour's delay can be very significant.

Gait deteriorates.



With various of the B vitamin deficiencies, nerves deteriorate. The person develops numbness, tingling, and weakness which affects the legs before the arms and hands. As a result, he has a broad-based gait and tends to use a cane or walking stick. With time, the weakness also affects his heart, causing him to develop heart failure.

- Overview of nutritional evaluation
- Evaluate the patient.
- ➔ **Evaluate his diet.**
- Now it's your turn.

Each culture and each socio-economic group within that culture is likely to have its own dietary assets and liabilities. Moreover, these parameters vary from year to year, depending on the weather conditions and trends in the international food markets.

Consider the local economy.



The author was surprised to find that the poorest of the poor, who ate only local foods, suffered with rising international food prices. NGO's were buying corn to feed Somali refugees. This drove the price of corn up, so local farmers sold to the NGO's. Hence, there was less available for the poor and middle-class local folks to buy. Prices escalated, at one point doubling within two weeks.

Analyze his diet.



Art Explosion

When you are new in a community in the developing world, go to the market and identify sources of carbohydrate, protein, fat, vitamins, and minerals. Write down prices. This will help you understand what the poor in your community must contend with as they determine how to spend their food budget.

What are his staple foods?



Brown rice is healthy as it contains B vitamins, but white rice, as shown here, is devoid of everything nutritious save carbohydrate calories. The bread on the right contains some wheat, but it is largely made of cassava flour which is likewise pure carbohydrate, devoid of any vitamins or minerals. It is fine for the majority of a person's calories to come from sources like this, but his diet should also include whole grains, fresh fruits and vegetables, and some source of vegetable or animal protein.

What are his sources of protein?



Art Explosion

Sources of animal protein are hard for the poor to acquire. However, sometimes they are available. In Uganda, some fishermen dry and then pulverize fish that are too small to sell in the market. This dry fish powder is available quite cheaply. The poor use it to flavor their diet of cooking bananas; the fish powder provides protein and minerals as well as flavor. The cheapest sources of protein are vegetable proteins, such as the lentils shown here.

What are sources of vitamins and minerals?



Art Explosion

Sources of vitamins and minerals vary from culture to culture. Most cultures don't have the variety of fresh fruits and vegetables shown here. In most developing areas, the diet of the poor is quite monotonous. Those who continually live on the edge of starvation have neither the inclination nor resources to vary their diet. Sometimes a monotonous diet is healthy, but more often it is grossly deficient in one or more important nutrient.

Are there special needs?



Pregnancy, wounds that need healing, and stunted growth are all special considerations. They require additional nutrients, all of them: calories, protein, vitamins, and minerals.

Are there special constraints?



Art Explosion

An adult who has few teeth cannot chew effectively. He needs a soft food.

The child on the right was the second-youngest of a group of five siblings. The baby just took her place at the breast. In her culture parents eat first, and then the rest of the food is put out for the children to fight over. Being younger and weaker than the others, she lost out. She needs supervised feeding and protection from her siblings.

Probably the most common constraint is milk intolerance. Some older children and adults lack the bowel enzyme to digest milk. If given milk or milk products, they vomit. They need to be given milk-free refeeding mixtures. These people usually gladly tolerate yogurt. The fermentation process in making yogurt eliminates the milk sugars that cause the vomiting.

Put together a plan.

- Advise how to buy and use local foods.
- Supplement the diet for a specific length of time.

An essential part of the treatment is the patient's education, teaching him how to buy and use local foods. It's not a kindness to allow him to become dependent on your food supply when, in fact, you cannot continue that supply indefinitely.

On the other hand, a helping hand with the current crisis is essential. Once the body is healthy and has accumulated a reserve, it can tolerate some deficiencies for periods of time without permanent damage.

Vitamin A prevents blindness.



One tragedy that may occur with refeeding is that the patient may become blind if his previous vitamin A intake was deficient or even marginal. Hence, before giving any refeeding mixture, it is essential to give him a dose of vitamin A. This will prevent sudden onset blindness.

Destroy the competition.




Your aim is to treat the patient, not the worms that inhabit his bowel. Deworm him. Additionally, chronic malaria or typhoid fever or brucellosis can be a continual drain on your patient, negating all your efforts to nourish him.

Introduce protein slowly.



It is tempting, when dealing with a critically malnourished child, to load him with a high-protein diet. This is a mistake. Particularly with kwashiorkor, protein must be introduced slowly. Initially most of the calories should come from carbohydrates, with very little protein. The protein content of the diet can be increased weekly. There are protocols for dealing with this. They are found in chapter 5 of the first volume of the medical manual.

- Overview of nutritional evaluation
- Evaluate the patient.
- Evaluate his diet.
-  • **Now it's your turn.**

Let's apply some of these principles to real patients.

Now it's your turn.



This youngster has 4 (and only 4) adult teeth in front. His height is 113 cm; his weight is 21 kg; his arm circumference is 16 cm. How does he fare on weight for age? Is his BMI adequate?

He is about 8 years old. His weight is the minimum for that age. His BMI is $2100/113 \times 113$. It is .164. He is malnourished.

Try this one.



This woman is about 35 years old. She weighs 27.5 kg. Her arm circumference is 16 cm. She is 149 cm tall. Is she malnourished? What should be her target weight for her height?

She is grossly malnourished. Her arm circumference would be normal for a 7 year old. Her BMI is $2750/149 \times 149$. It is 0.124. She is profoundly malnourished. Note how her clothing covers her emaciated appearance.

And this one.



This child's mouth is full of baby teeth. She can almost touch her ear on the other side. Height 81 cm.; weight 7.6 kg; arm circumference 9 cm. What do you think about her nutritionally?

She is about 5 years old. She has swollen feet, so the BMI will be abnormally high. Nevertheless, if you calculate it, it comes out to $760/81 \times 81 = .116$. She is profoundly malnourished. Her BMI will drop as she improves; the swelling in her feet will disappear, as well as the fluid in her abdomen. She will look worse before she begins to look better.

How about Tadalech?



This girl reports that she is 12 years old. She is 149 cm tall and weighs 38 kg. Is she adequately nourished?

She looks healthy. Nevertheless, remember that clothing covers a lot of malnutrition. Her BMI is $3800/149 \times 149$. This equals 0.171. She is malnourished, but not profoundly.

One from the other end



Supposing this woman weighed 110 kg and was 168 cm tall. What was her BMI?

Her BMI is $11000/168 \times 168$. It is 0.39. She is obese.

This 1 y.o. is not thriving.



This child is a year old. His height is 66 cm. His weight is 6.1 kg. His arm circumference is 10 cm. His hair is black and curly but it is very thin. He does not respond either positively or negatively to a strange white face coming near and examining him. What is his BMI?

His BMI is $610/66 \times 66$. It is .14. He is malnourished

And a cutie for the last one.



This little princess thinks she is almost ready for school. Do you agree? She has all her baby teeth but has not yet lost any. She is 107 cm tall and she weighs 16 kg. Does she need nutritional support?

Her BMI is $1600/107 \times 107$. It is .140. She is malnourished.

THE END

Suggestions, comments, and questions
are welcome.
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