# Nutritional Assessment (HNFS-2101)

**By:**
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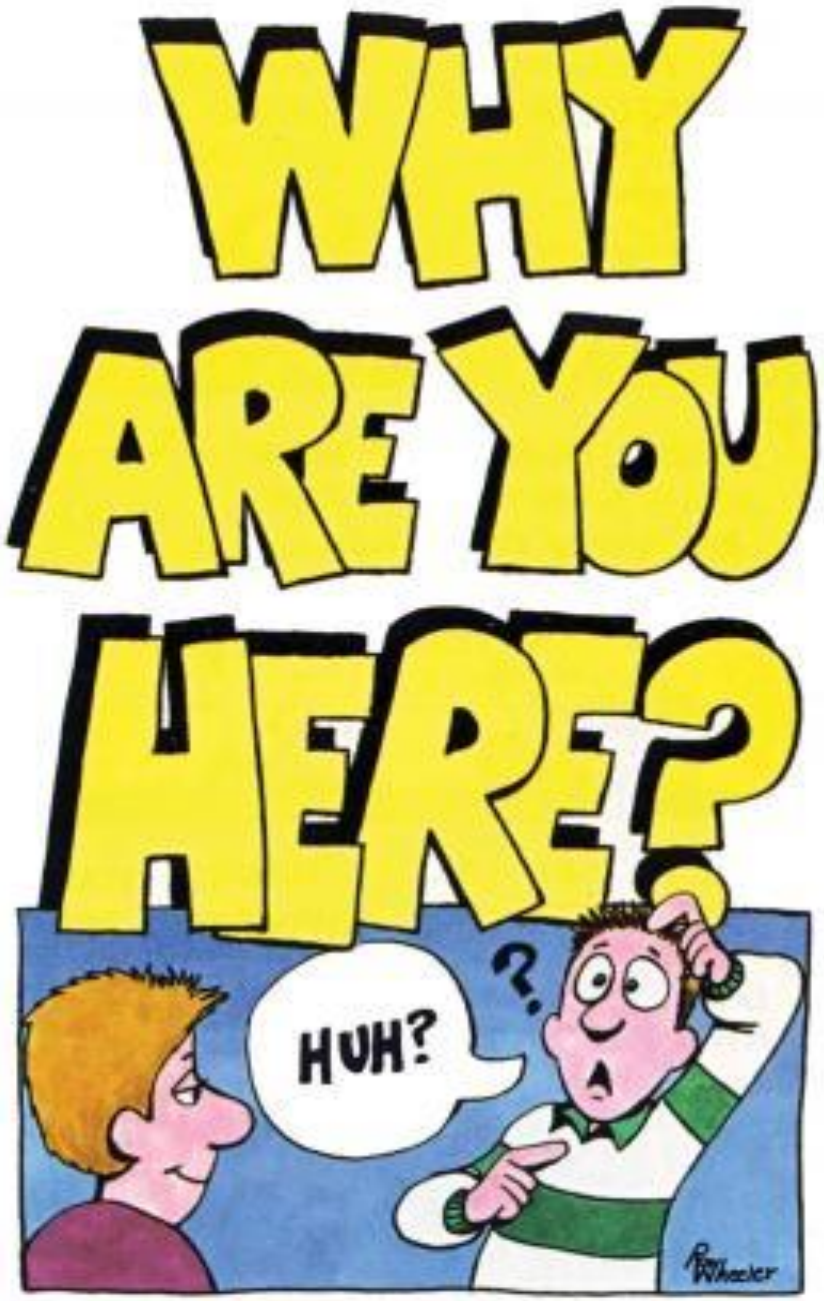



1.

2.

3.

4.

5.

# WHY YOU ARE HERE?

✍ ***In order to Provide high-quality nutrition care:-***

- *Doing the right thing*
- *At the right time*
- *In the right way,*
- *For the right person, and*
- *Achieving the best possible results.*

# “”lesson 1””

- **By the end of this lecture the students should be able to:**
  - Define nutritional assessment
  - Explain about the purposes of nutritional assessment
  - Identify ABCDE methods of nutritional assessment methods

# INTRODUCTION

## 1.1 What is Nutritional assessment?

- **Nutritional status**
  - It is the degree to which an individual's physiological need for nutrients is being met by the food he/she is eating.
  - **Health status of individuals or population groups as influenced by intake & utilization of nutrients**
  - **is often the result of many inter-related factors.**
  - **It is influenced by food intake, quantity & quality, & physical health.**
- **Assessment**
  - **A process of gathering, analyzing, & interpreting information**

# INTRODUCTION…..

- **Nutritional assessment**
  - Gathering, analyzing & interpreting information from dietary, biochemical, anthropometric & clinical studies.
  - It is collecting information about a client's medical history, anthropometric measurements, clinical and biochemical characteristics, dietary practices, current treatment, and socioeconomic situation including food security.

# ASSESSMENT OF NUTRITIONAL STATUS

- Nutritional assessment is the process of estimating the nutritional position of an individual or group, at a given point in time, by using proxy measurement of nutritional adequacy.
- It provides an indication of the adequacy of the balance between dietary intake and metabolic requirement.

# CONDITIONS AFFECTING THE NUTRITIONAL STATUS

I. Direct links

a) Dietary intake

- Quantity
- Type of food
- Meal pattern

b) Infection

II. Indirect links

a) Income

b) Education level

c) Environmental

d) Cultural

# USES OF NUTRITIONAL ASSESSMENT

a. Diagnostic tool; (individual and group)

- Does a nutritional problem exist
- Type of problems
- Magnitude of the problem
- Who are affected by the problem
- What are the causes of the prob

# USES OF NUTRITIONAL ASSESSMENT

a. Diagnostic tool; (individual and group)

- Does a nutritional problem exist
- Type of problems
- Magnitude of the problem
- Who are affected by the problem
- What are the causes of the prob

b. Monitoring tool (individuals & group)

- Requires repeated assessment over time
- Has the situation changed?
- Direction and magnitude of change

C. Evaluation tool (individual or group). To what extent has the intervention, treatment, or programme had the intended effect (impact)

# INTRODUCTION ….

## 1.2. What is the purpose of nutritional assessment?

- Identify individuals or population groups **at risk** of becoming malnourished
- Identify individuals or population groups who **are malnourished**
- To **develop health care prog**rams that meet the community needs which are defined by the assessment
- To **measure the effectiveness** of the nutritional programs & intervention

## 1.3 Nutritional assessment methods

- Nutrition is assessed by two types of methods:
  - *direct
  - *indirect.
- The direct methods deal with the individual and measure objective criteria, fall into four main categories ??
- Indirect methods use community health indices that reflects nutritional influences.

# INTRODUCTION ….

## Direct methods

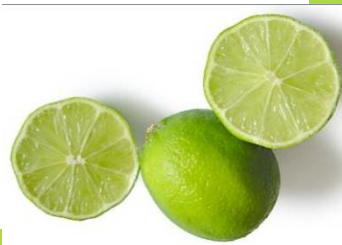
**These are summarized as ABCD**

- Anthropometric
- Biochemical/laboratory
- Clinical
- Dietary

## Indirect methods(E)

These include three categories:

- Ecological variables such as  crop production
- Economic factors  e.g. per capita income, population density & social habits
- Vital health statistics particularly infant & under 5 mortality & fertility index



# INTRODUCTION ….

- It is important to note that each method by itself does not provide a complete picture of a person's nutritional profile,
  - ✓so it is necessary to use them in combination to obtain a more complete assessment.
- Once this has been done, appropriate interventions can be planned and implemented or referrals for further examinations made.

# INTRODUCTION ….

- Anthropometry is the measurement of body height, weight & proportions.
- an essential component of clinical examination of infants, children & pregnant women.
- used to evaluate both under & over nutrition.
  - Measured values reflects the nutritional status.

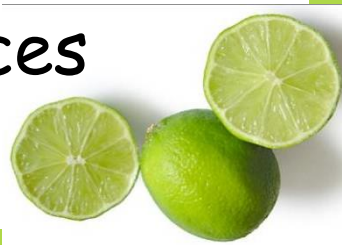
# INTRODUCTION ….

## 📖What to measure ??

- Height
- weight
- Mid-arm circumference
- Skin fold thickness
- Head circumference
- Head/chest ratio
- Hip/waist ratio

# "Lesson 2"

- By the end of this lesson students will be able to
  - Describe the different nutritional assessment system
  - Identify nutrition interventions & the different designs under it
  - Describe what it means by the nutritional assessment indices and indicators
  - Identify the design of nutritional assessment systems
  - Evaluate the nutritional assessment indices



# Introduction

- nutritional assessment  system Can take one of four forms :
    - Surveys
    - Surveillance
    - Screening or
    - Intervention

# 1.4 Nutritional assessment systems

## 1.4.1 Nutrition surveys

- **Data collected only once**
  - establish baseline nutritional status of a population
  - formulate policies
  - identify geographic areas and/or sub-population groups at risk for *chronic malnutrition*

# Nutrition Survey ……

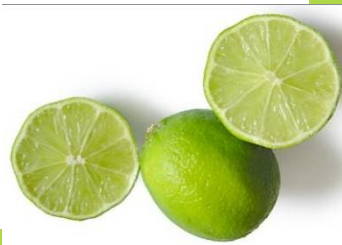
- Cross sectional assessment of nutritional status on selected groups.
- Can describe populations subgroups who are at risk for chronic malnutrition
- Information is used to allocate resource to subgroups and to formulate policies to improve the over all nutritional status of the population
- Limited use to identify causes.

# 1.4 Nutritional assessment systems…….

## 1.4.2 Nutrition surveillance

- *Data collected over time on same groups*
  - can identify both acute and chronic malnutrition
  - seasonal differences identified
  - possible causes of malnutrition for intervention programs
  - monitoring policies; evaluating nutrition interventions

- Nutritional surveillance ------
  - Continuous monitoring of the nutritional status of the populations groups
  - Data are collected , analyzed and utilized for extended period of time
  - Can be used to identify the possible causes of malnutrition
  - Used for decision making  by policy makers for disposal of resources , formulation of prediction based on current trends ,and the evaluation of nutrition programs



# 1.4 Nutritional assessment systems……

## 1.4.3 Nutrition screening

- Data collected on whole population or only those "at risk"
  - for identification of individuals requiring intervention
  - simple and cheap measurements for large scale surveys
  - data: compared to cutoffs to assess proportion "at risk"

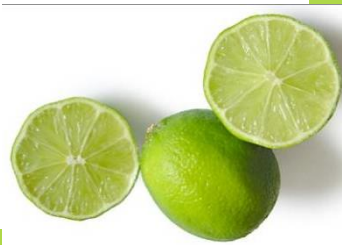
# 1.4.4 Nutrition interventions

- Nutrition interventions targets on population subgroups identified as **at risk** during nutrition surveys or by nutrition screening.
- Examples of nut. Interventions are:-
  - Nutrition education
  - Supplementation
  - Food-based strategies
    - Fortification
    - Dietary diversification/ modification
    - Biofortification

# 1.5 Designs of nutrition assessment systems

interventions require M & E which intern needs different designs

- Within group design
- Between-group quasi-experimental design
- Randomized controlled, double-blind design



# 1.5.1 Within group design

- Adequacy evaluation (e.g.…?)
- Intervention is done to all target group
- Baseline and final measurements on target group
- No control group: so any improvement cannot be causally linked to intervention
- E.g. Iron supplements to anemic preschoolers

## 1.5.2 Between group quasi-experimental design:

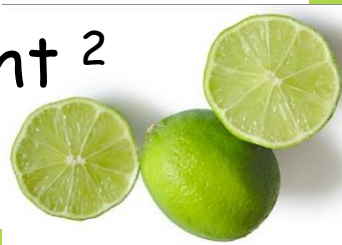
- Plausibility (apparently probable) evaluation
- Experimental group receive intervention but the control group does not
- Subjects not randomized but preferably "blinded"(use an identical placebo)
- Confounders removed by statistical analysis
- Require more resource, expensive
- For greater degree of certainty about relation of outcome and nutrition intervention

# 1.5.3 Randomized-controlled, double blind design:

- Probability evaluation: intervention responsible for outcome
- Subjects randomized to treatment or control to minimize bias
- Randomize by individual; by health center etc
- Double blind: both the subjects and the researchers do not know which subjects are in which group
- Expensive

# 1.6 Nutritional assessment indices & indicators

- **Raw measurements**
  - Weight, height, red blood cell count (RBCC)
- **Indices (singular: index)**
  - constructed from >=2/more raw measurements
  - necessary for interpretation of measurements
  - weight-for-length: wasting;
  - Weight-for- age: underweight
  - height-for-age: stunting
  - Body mass index (BMI): weight / Height $^2$



- **Indicator: used at population level**
  - comparison of indices in relation to cutoffs
  - **is an index + a cut-off point.**
  - must be chosen to meet study objectives

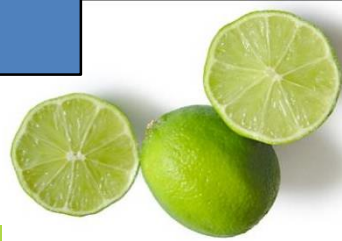
  - E.g. prevalence of serum retinol < 0.70 umol/L > 15%: high risk vit A deficiency

  - E.g. prevalence of HAZ scores < -2 SD in children > 20%: high risk for stunting

MEASUREMENT

INDEX

INDICATOR



# 1.7. Factors influencing the design of a nutritional assessment system

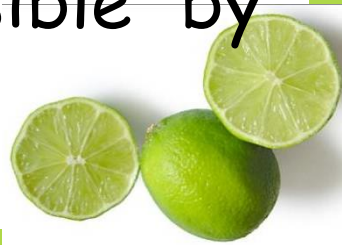
- Study objectives
- Sampling protocols
- Sample size
- Validity
- Reproducibility or precision
- Accuracy
- Confounding
- Sensitivity and specificity

- Prevalence
- Predictive value
- Time and resources
- Other factors:
  - Acceptability of methods;
  - respondent burden; equipment;
  - data processing costs

# 1.7. Factors influencing the design of a nutritional assessment system

## Sampling

- **Non-probability sampling**
  - For example : convenience sampling
    - Results in non-response bias: ignoring people who do not respond to an initial attempt
    - Seasonal bias: collecting data at only one season
    - Tarmac bias: only subjects accessible by road

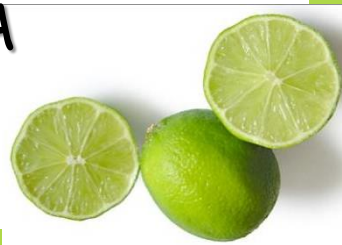


# 1.7. Factors influencing the design of a nutritional assessment system

- **Sampling**
- **Probability sampling**
  - Simple random sampling
  - Stratified random sampling
    - weighting sample
    - proportional stratification e.g. sample depends on size of each school
  - Multistage random sampling: e.g. DHS survey

# 1.7. Factors influencing the design of a nutritional assessment system

- **Validity**
- Is the adequacy with which a test/index reflects the parameter of interest
  - level of body store:
    - serum Ferritin for Fe store
  - recent dietary intake:
    - serum or urine vitamin C
  - chronic nutritional status:
    - hair Zn, toenail Se, breast milk vitamin A



# 1.7. Factors influencing the design of a nutritional assessment system

- **Accuracy**
- Is the extent to which measurement is close to "true" value
  - Function of **systematic measurement error** (cause a result to depart from true value in a consistent direction)
    - e.g. contamination; recent meal; under-reporting; Weighing scale etc.
- Influenced by non sampling error (systematic bias)

# 1.7. Factors influencing the design of a nutritional assessment system

## Reproducibility or precision

- Degree to which repeated measurements of same variable give same value.
- Function of random measurement errors (generate a deviation from correct result due to chance) + within subject variation
- Reduced by: training; standardization; calibrated equipment; duplicates.

## Reproducibility or Precision , “reliability”

- Influenced by **sampling error (random error)**

- The precision of each measurement procedure can be calculated and expressed as CV%

$$CV\% = \frac{\text{Standard Deviation} \times 100\%}{\text{Mean}}$$

- Adversely affected by , random error contributed for by the measurer, the respondent, or the instrument

- **D/ce b/n precision and accuracy?**

# Training is still a challenge

**Accuracy**

Accuracy is how close a measured value is to the **actual (true) value**.

**Precision**

Precision is how close the measured values are **to each other**.

Low Accuracy
**High Precision**

**High Accuracy**
Low Precision

**High Accuracy**
**High Precision**

# 1.7. Factors influencing the design of a nutritional assessment system ….

- **Sensitivity:**
  - ✓ Is the ability of a test/index to identify those genuinely malnourished
- **Specificity:**
  - ✓ Is the ability of a test/index to identify those genuinely well nourished
- **Prevalence**
  - Is the number of persons with the disease in a given time period
- **Predictive value**
  - Is the likelihood that a test correctly predicts the presence or absence of malnutrition

| Test result | Diseased | | |
|---|---|---|---|
| | Yes | No | Total |
| Positive | a (TP = true positives) | b (FP = false positives) | a+b (Total no. of positive test results) |
| Negative | c (FN = false negatives) | d (TN = true negatives) | c+d (Tot no. of negative test results) |
| Total | a+c (Total no of diseased persons) | b+d (Total no. of non-diseased persons) | a+b+c+d (Total tested) |

# Formulas are as follows

- Sensitivity =a/(a+c)
- Specificity =d/(b+d)
- False-positive error rate =b/(b+d)
- False-negative error rate =c/(a+c)
- Positive predictive value =a/(a+b)
- Negative predictive value =d/(c+d)
- Prevalence = (a+c)/(a+b+c+d)

- Sensitivity and specificity affected by:

  - Random measurement error
  - Non-nutritional factors ( e.g. infection , diurnal variation)
    - Infection lowers serum zinc, elevate serum ferritin
  - Biological and behavioral process ( e.g. LBW as indicator of neonatal mortality, i.e. higher when it is due to prematurity than IUGR)
  - The cutoff point used
    - Decrease in cut off decrease sensitivity but increases specificity ( and vice versa)

Effect of change in cut-off point on the sensitivity and specificity of MUAC, and Total Iron Binding Capacity ( TIBC)

| Parameter | Cutoff | Sensitivity | Specificity |
|---|---|---|---|
| MUAC(cm) | <14cm | 90.4% | 82.7% |
| | <12.5 cm | 55.8% | 98.5% |
| TIBC (µg) | <310 | 55% | 68% |
| | <270 | 30% | 87% |

# Prevalence

- Is the proportion of individuals who really are with nutrition disorder (the sum of TP and FN) divided by the total population (TP +FP +TN +FN )
- If the condition is less prevalent e.g. hypercholesterolemia ), it becomes less likely that the individual with positive test has actually the disease
- The lower the prevalence , the more specific the test must be to be clinically useful.

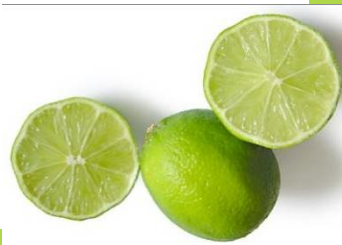
# Predictive value

- Likelihood that an index correctly predicts the presence or absence of nutrition disorder or disease
- Divided into two:
  - Positive predictive value (PPV) = the proportion of positive tests that are truly positive
  - Negative predictive value( NPV) =the proportion of negative tests that are truly negative
- Predictive value varies with
  - Sensitivity
  - Specificity
  - Prevalence of the nutrition disorder or disease

**Bayes' theorem** : gives the formula for calculating PPV and NPV of a test, knowing test sensitivity (Se) and specificity (Sp), and the prevalence of disease in the population tested (P):

$$\textbf{PPV} = \frac{Se * P}{Se * P + (1-Sp)(1-P)}$$

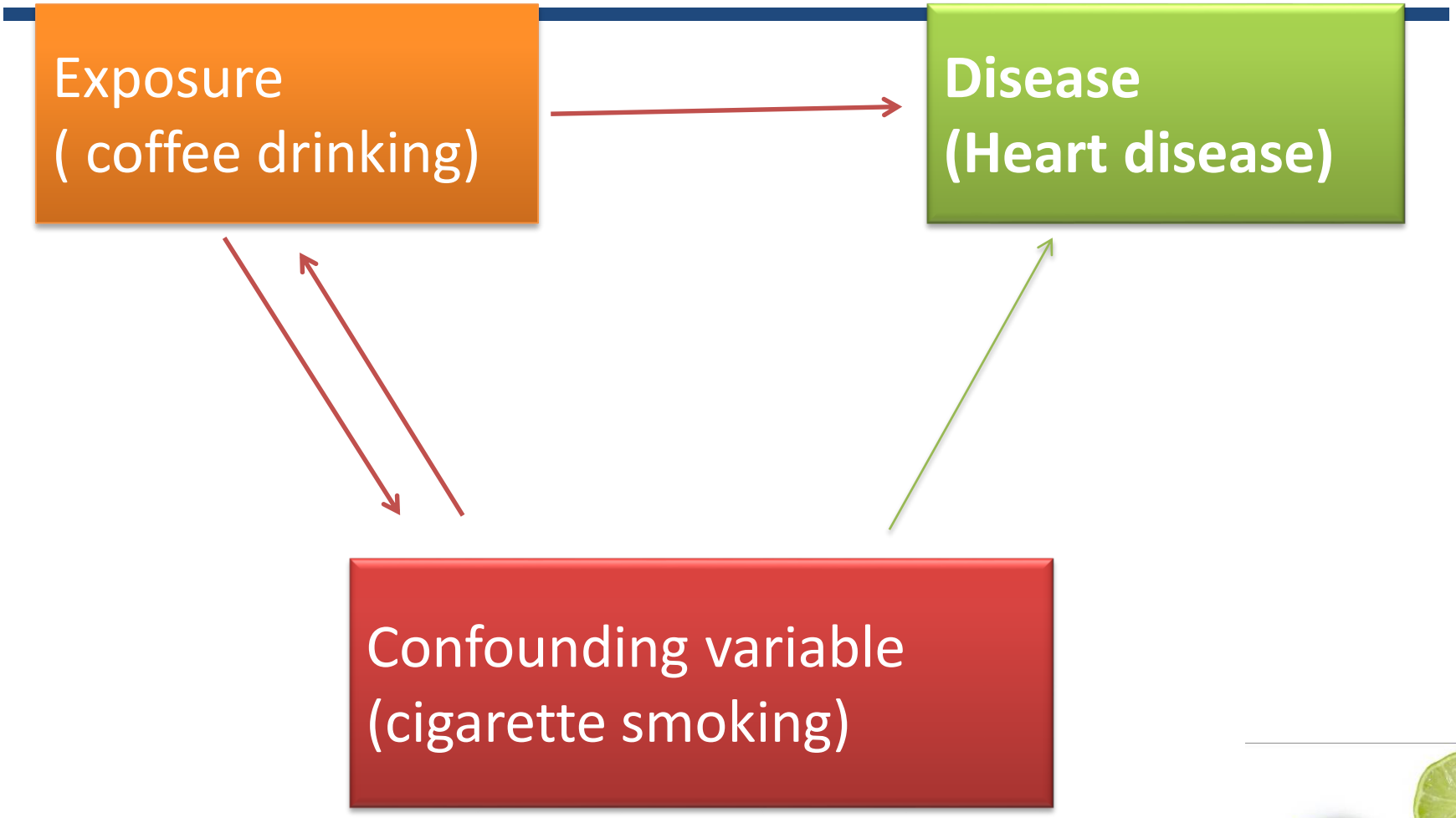
$$\textbf{NPV} = \frac{Sp * (1-P)}{Sp*(1-P) + (1-Se)*P}$$



# 1.7. Factors influencing the design of a nutritional assessment system

- **Confounders**
  - ✓ A confounder may be a biological or technical factor which may confound the interpretation of the test result
  - ✓ Four sources of confounders may exist:
    - Sampling
    - Measurement
    - Analytical
    - Biological

# The relationship of exposure, disease and the confounding variable



# 1.8 Evaluation of nutritional assessment indices

- **For populations:**
  - By comparison with distribution of reference values using percentiles, z-score, percent of median
  - Compare distributions among populations
  - Calculate percent of persons with indices below:
    - reference limits; cutoff points; trigger levels
- **For individuals:**
  - Compare value with:
    - percentiles from reference population
    - cutoff points

# The concept of reference values and the relationship of recommended terms

Reference individuals

Composed a

Reference population

From which is selected a

Reference sample group

On which are determined

Reference values

On which is ob served a

Reference distribution

From which are calculated

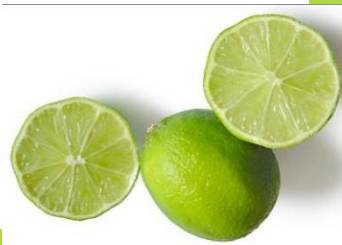
Reference limits

That may define

Reference intervals

# 1.8.1 Reference distribution

- Distribution of measurements, preferably derived from a reference population of healthy persons
- For comparison of the observed values of an individual with the reference, there should be matching for the factors known to affect the measurement
  - E.g. Age, sex, race, etc



# 1.8.2 Reference limits

- Specific percentiles for the reference population
- Reference distribution is used to drive the reference limit
- Individuals can be classified as unusually low, usual, or unusually high compared with the reference limit
- E.g. anthropometric indices in industrialized countries:
  - $3^{rd}$ or $5^{th}$ percentile as unusually low
  - $95^{th}$ or $97^{th}$ percentile as unusually high

# EXPRESSING ANTHROPOMETRIC MEASUREMENTS

**Percent of the median expressed as,**

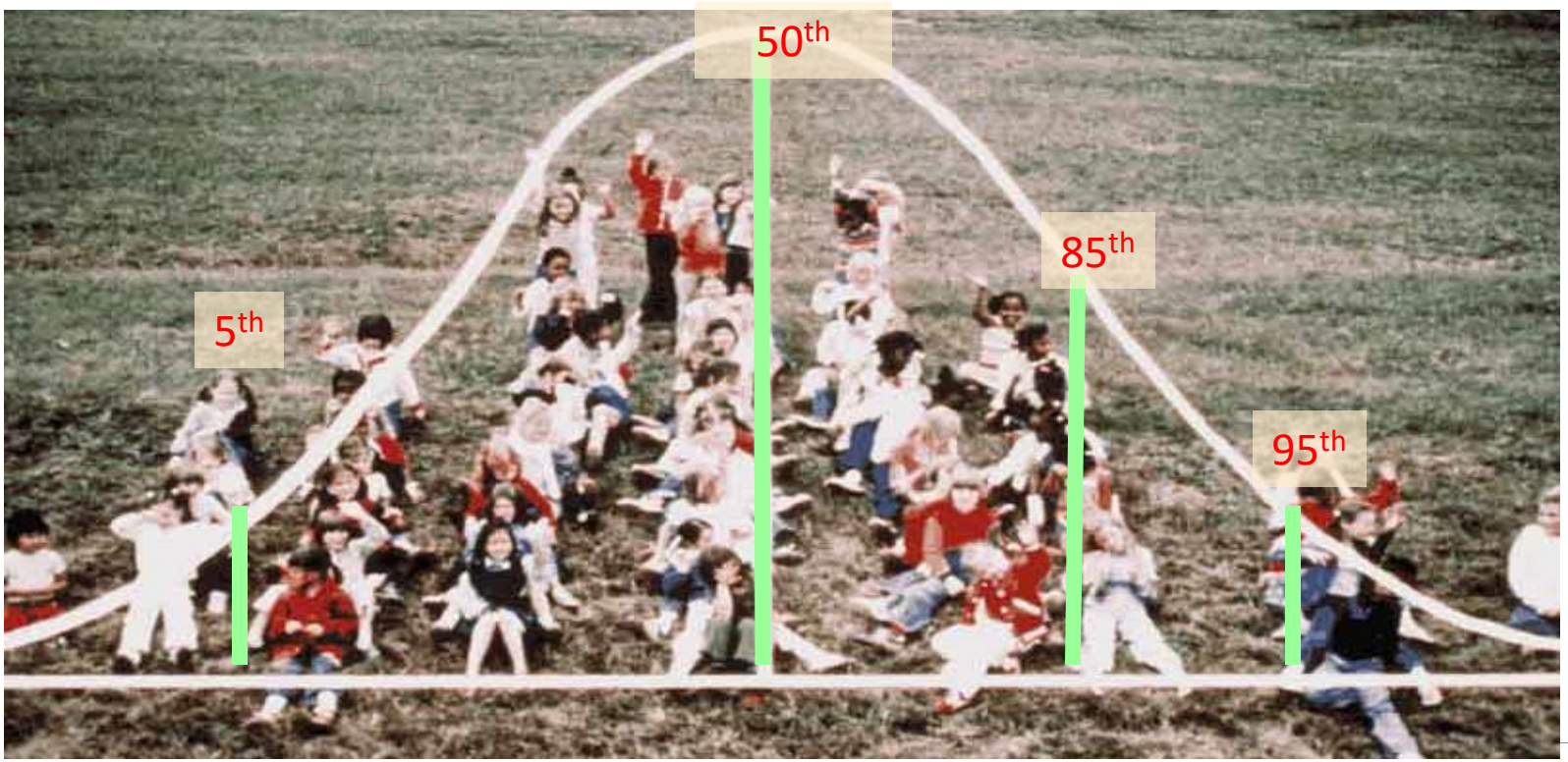
$$P = \frac{\text{Weight or height Value of the subject}}{\text{(Median height or weight value of the reference of the same age)}} \times 100$$

**80 % of the median is a cut-off point for under nutrition**

**. Centiles, Expressed** according to the value of the subject in reference to NCHS's 3rd, 5tyh, 10th and 90th centiles

**Usually the 3rd centiles is taken as a cut off point for labeling malnourished subject**.

# What is a Percentile/ Centile?




Major Percentile Divisions

# WHO reference limits for hemoglobin*

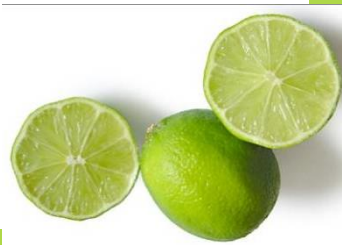
| Age | Hemoglobin g/L |
|---|---|
| 0.5-5 y | <110 |
| 5-11 y | <115 |
| 12-13y | <120 |
| Men | <130 |
| Women | <120 |
| Pregnant women | <110 |

Based on 2.5$^{th}$ percentiles

From Stolzfus & Dreyfuss (1998)

# 1.8.3 Cutoff points

- Are based on data from subjects with clinical or functional disturbances
- Their use is less frequent than reference limit
  - b/c information relating tests & sign of deficiency is often less available
- Sometimes more than one cutoff point is selected
- E.g. two cutoffs of BMI(body mass index) for over nutrition: BMI>25overweight, >30 obesity



# 1.8.4 Trigger levels

- Level of an indicator at which there is public health concern
- E.g. :WHO Indicators for risk of deficiency as public health problem
  - Risk of Zn deficiency
    - Rate of stunting (HAZ < - 2SD) > 20%
    - Prevalence of inadequate Zn intakes > 25%
    - Prevalence of low serum Zn > 20%
  - Risk of vitamin A deficiency
    - Children 2-5 yr night blindness > 1.0 %
    - Serum retinol < 0.70 µmol/L > 15%

# Quiz 1

1. What are the two major categories of nutritional assessment methods?
2. Write types of nutritional Assessment systems
3. Write types of nutrition Interventions
4. Write designs of nutrition interventions
5. The difference b/n raw measurement; indices and indicators by giving examples