UNIVERSITATEA DE MEDICINĂ ŞI FARMACIE „VICTOR BABEŞ” DIN TIMIŞOARA

PREPARATION OF BACHELOR DEGREE

PRACTICAL COURSES

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GRAPHICAL PRESENTATION

The tables, although they very accurately reproduce the quantitative aspects of a investigated phenomenon, being at the same time synthetic and systematic, still require some specialized training in order to be able to be followed and understood. As such, they can be used in scientific research papers presented in the form of articles in specialized journals that are addressed to a properly trained audience. They render more static aspects of the investigated phenomenon, loading tables with data for long periods of time makes it difficult to track and understand them.

Graphics, though less accurate than tables, have a wider scope of use as they are more intuitive and can be easily traced and understood by a wider audience.

MAIN COMPONENTS OF A GRAPH

The graph is actually a map that "speaks" directly to the eye and is very effective in creating an image in the mind of the receiver. Building a graph means both science and art. It means knowing the basic graphs, the technical way of realizing them and especially how the basic elements are combined to create an appropriate map; choosing the type of graphic representation for difficult, complex situations of the evolution of phenomena actually means art. The person who makes the chart assumes a great responsibility because a correct graph leads to correct information and an incorrectly constructed and thought graph leads to misinformation (Anders Wallgren, Britt Wall-gre, Rolf Persson, 1990). When a graph is viewed, the eye must immediately record the main features as well as some details; for this the person who builds the graph must strike a balance between the detail and the whole. A graph stimulates the receiver to make connections and immediately observe the patterns that may occur in the evolution of a phenomenon.

The role of the graph:

- to guide the user in selecting important information from the statistical report (“gateway”);
- develop further ideas and explain them;
- to encourage the user to look deeply into the problem presented in the statistical report;

- encourage comparison and analysis of information.

Graphics are built using simple elements such as lines, areas, text, etc. All of these simple elements need to be combined so that the resulting graphic makes sense and can be read easily.

The person responsible for the graphic representation should ask the following question:

What type of graph is appropriate for graphical representation of statistical data?

- The choice depends first and foremost on the problem that we want to highlight by graphical representation.
- There is no rule establishing a correspondence between a certain type of relationship between variables and a certain type of graph. Different factors must be considered for each situation.
- We sometimes have a choice between:
- a graph that is appropriate and unsuitable for a particular situation or,
    - between several types of graphs suitable for the same situation We must first decide what we want to highlight with the help of that graph: evolution over time, variations, etc. The main characteristics of the data must be emphasized and the limits imposed by them must be taken into account.

The important characteristics in this context are:

- *data structure*
- *type of variables*
- *the characteristics of the measurements.*

The main components of a graph are:

1. the representation area ("chart area")

2. the surface of the plot bounded by axes and quadrant

3. the graph area

4. the legend of the graph

5. axis network - horizontal and vertical lines (gridlines)

6. the labels corresponding to the axes

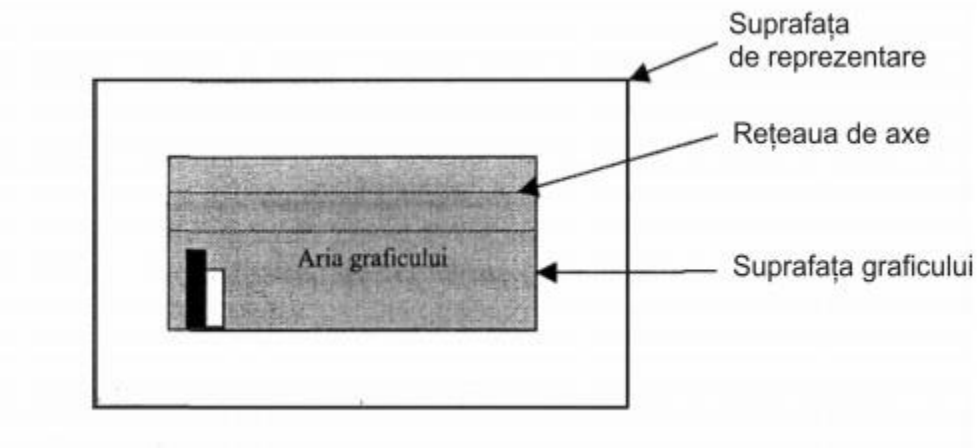

Fig. 1. The main components of a graph

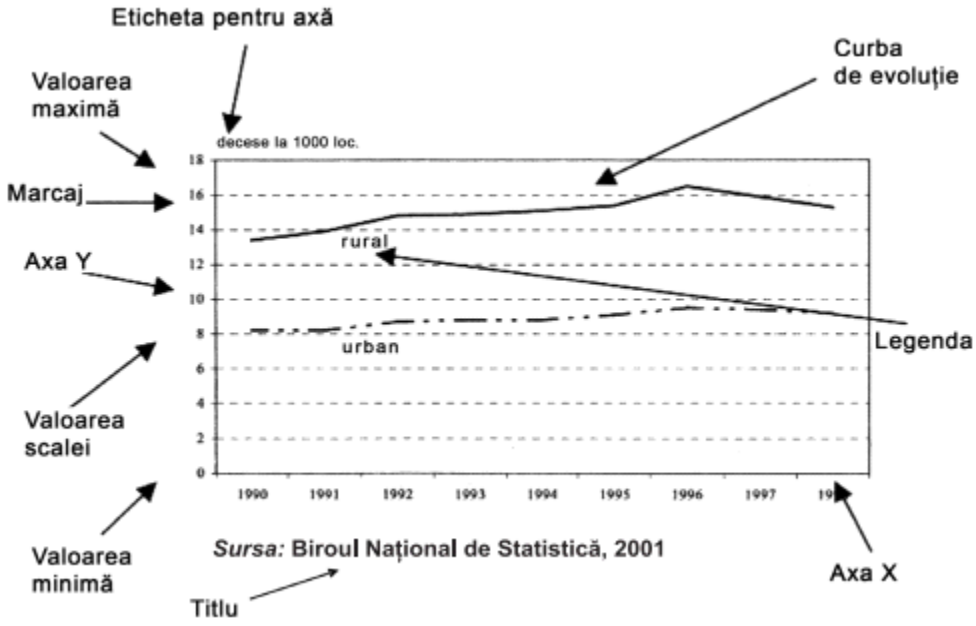

Fig. 2. Mortality rate of population by area in locality X during 1990-1999.

From the point of view of the construction technique the graphs can be grouped unconventionally into two types of graphs:

- ✓ Basic, basic graphs (histogram, polygon, warp, linear diagram);
- ✓ Speciale Special graphs (column diagram, population / age pyramid, pie charts), statistical maps, maps with different symbols, semilogarithmic charts, etc.

❖ FUNDAMENTAL GRAPHS

The series of variation can be represented by the following types of distribution diagrams: histogram, polygon, warp and linear diagram, among these types will be described histogram and linear diagram that are frequently used in health research.

The histogram is a graphical representation, by adjacent rectangles, of the distribution of frequencies or percentages. It is used when the author of the graph wants to show the frequency for a continuous variable (for example age). The histogram can also describe the percentage distribution. The frequency of cases (or percentage) for each category is represented by a rectangle. The area of the rectangle is proportional to the frequency of the cases in that category.

Area of the rectangle = Base × height

The scale of the categories of the variable is represented on the "X axis" by equal distances. The frequency scale is represented on the "Y axis" by equal distances corresponding to the equal frequencies. The Y axis always starts from the "0" point to avoid problems that may arise when comparing the bases. The X axis, however, starts from any convenient (lower) point on the axis. The objective is to obtain a figure with the total area equal to the total frequency N (or the total percentage 100%).

Example:. In Tab. below are the data needed to construct a histogram.

School years	**Frequency distribution**	**Frequency for every category of investigated patients (%)**
4 years	21	9,4
5 years	53	23,8
6 years	69	30,9
7 years	47	21,1
8 years	33	14,8
	N = 223	100,0%

The histogram uses absolute or relative values.

The technique is the same, but the Y axis represents absolute or relative values depending on the situation. The X axis represents the variable we measure (the class interval), and the Y

axis represents the frequency for each class interval; the height of the rectangle is proportional to the number of people in that category.

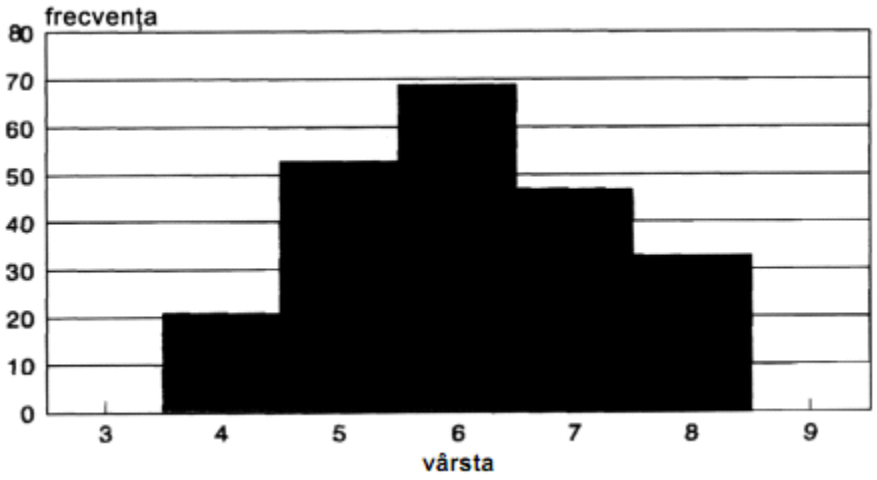

Fig.3. example of a histogram

Some variations of the basic histogram are used to reflect certain characteristics of the data. For example, if the variable is "nominal" the rectangles in the histogram can be separated so as to view the categories separately and distinctly. Usually this graph is also called the column diagram and the rectangles have equal widths.

For "ordinary" variables, where no equal distances are defined, rectangles can have spaces between them to highlight this (particularly if the variable is discrete and less if it is continuous). In this case, the histogram can be of a scale type and gives the impression of ordering the categories (the marking is inside each column). For ordinary variables there is the tradition of taking a standard width, although distances are not defined. This avoids the apparent distortions that may occur due to the variation of the widths.

The histogram is suitable for discrete "range of variation" variables. If the variables are of the "continuous" type, there are other types of graphs more suitable (for example, the frequency polygon).

Frequency polygon

The polygon of frequencies or percentages is a closed figure that unites the points between the interval centers and their frequencies. It is an alternative to the histogram.

Another way of graphical representation is the cumulative distribution of frequencies or percentages. This type of graph shows the frequency, respectively the percentages of the cases located below the upper edge of each successive class.

Linear diagram (timeline or histogram)

It represents the specific form for representing dynamic, chronological series. It is used to describe the evolution over time of a phenomenon (birth, fertility, mortality, etc.).

The linear diagram shows the value of certain dependent variables (represented on the Y axis) for each category of the independent variable (represented on the X axis). The points on the graph are joined by a straight line, and the figure is not closed with the x-axis. The area under the curve does not have a particular meaning as in the case of histograms or polygons.

In this type of graph the eye easily follows the evolution curve and immediately notices the changes that have occurred over time in the evolution of the observed phenomenon. It is commonly used to monitor the health status of a community (birth, mortality, morbidity).

The figure below is an example of a linear diagram. The independent variable is the time (represented by the X axis) and the dependent variable is the rate (represented by the Y axis).

This type of graph is useful when one of the variables (on the x-axis) is continuous, that is to say, an interval type variable (eg age and time).

A column diagram can also be used if the variables on the X axis are nominal or ordinal. In this case the vertical bars are more suitable for comparison. For the chronological series, the visual tracking of the columns in order to observe the evolution is more difficult.

In the linear diagram the curves for the chronological series are much easier to trace and at the same time provide a description (a drawing) of the evolution over time of the observed phenomenon.

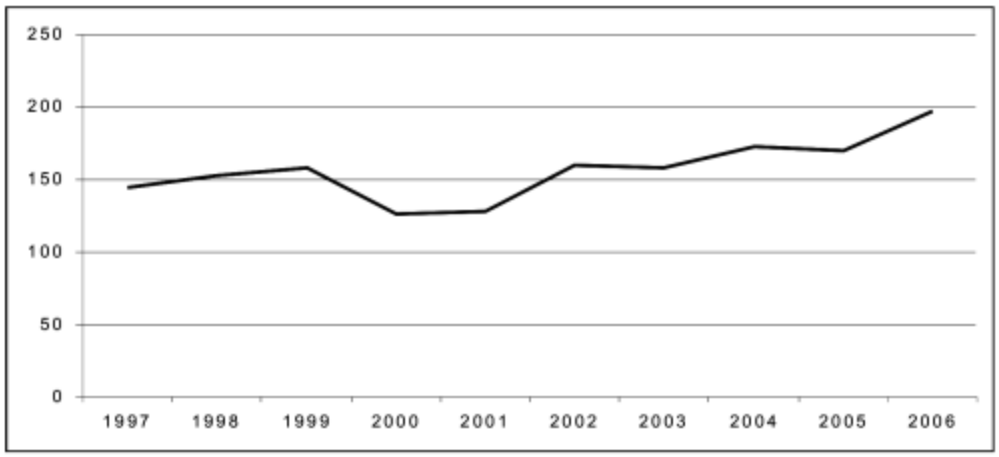

Fig. 4 The incidence of gingivitis in female persons, smokers in Timiş county between 1997 and 2006

Caution

• The Y axis must be ¾ of the length of the X axis (or the same length).

• The frequency or percentage axes always start from point 0 or from the origin. Scores axes can start from any convenient score to get a clear diagram.

• Be sure that equal numerical differences are represented by equal physical distances on all scales.

• Correct labeling of the graph - including scales, data source, explanatory title, explanatory notes, etc.

• Avoid confusion: do not represent multiple different graphs using the same axis system.

❖ **SPECIAL GRAPHICS**

Column diagram

It is the simplest form of graph. This type of chart is used when following:

- representation of several phenomena at the same place and at the same time, or
- the same phenomenon in several places but at the same time (eg the periodontal rate according to the risk factor in 2012).

The column diagram is easy to graph and easy to read. It is used when we want to represent distinct values of the variables - qualitative or discrete variables. To illustrate this, the columns are separated by spaces.

They are used for graphical representation of absolute frequencies or relative frequencies, sums or averages.

Variables are represented on the X axis, while frequencies are represented on the Y axis.

The use of percentages makes it much better to compare sets of data of different sizes.

The columns must be wider than the spaces between them, and the spaces must be well defined so that the column-type graph cannot be confused with a histogram.

The axis network is useful for comparisons and for approximate reading of values. If the axes of the network are too large, the graph is difficult to read, and if they are in too small their presence is not justified.

From the point of view of orientation, the bars can be:

- vertical
- horizontal

In order to highlight the contents of the chart, several principles will be respected.

Bar ordering

- the proper ordering of the values of the variable offers a better graph;
- for a qualitative variable there is a freedom in ordering its values;
- arranging the values in decreasing order of frequencies creates a greater interest;
- the non-ordering of the values gives a chaotic image.

Bar grouping is recommended in two situations:

- to simultaneously describe two or more different categories; categories are represented in the same axis system;
- different sizes or colors are used to differentiate the categories and a legend is attached to the graph.

It is recommended not to represent more than two or three categories, a larger number will make it difficult to understand the graph (for example: male, female; urban, rural; employee, employer, self-employed).

If there are a larger number of categories, more graphs with common columns will be used.

The grouped columns are represented either vertically or horizontally. The two graphs produce different effects, even if the area has the same size in both cases.

In the case of horizontal columns, the percentage axis is long, so that differences in values can be observed more clearly.

An alternative to the grouped columns is the partially overlapping bars. The advantage in this case is given by the space saving, and the graphic representation becomes more interesting. However, there is a risk that the overlay will make the graph difficult to understand or lead to misunderstandings.

It is recommended if:

• all the values of one category are lower than the values of the other category;

• there is the possibility to represent the category with smaller values in front of a lighter color.

An alternative to grouping columns is columns arranged in the form of "stacked charts". It is known as structure diagram through rectangles. The rectangles are represented one above the other. In this case, the area of the rectangle that represents the entire community (100%) is divided into parts proportional to the specific weight of each component that makes up the whole. A relatively small number of components (variables) is recommended.

For the value of each variable, the column height corresponds to the total frequency of the respective category. Precisely, only the size of the base category can be read; the other categories can be approximated.

The different sizes or colors indicate the division of the total into the component categories.

Overlapping columns vs. "stacked" columns both represent similar situations

- the choice is limited to what we want to emphasize the most;
- in the case of overlapping columns it is easy to compare different categories but more difficult to understand what is happening at the level of the whole category;
- in the case of "stacked" columns, the assembly is visible, while the size of each category is secondary.

The same information can be represented from two points of view using two types of graphs.

Structure diagram that uses the pie chart as a representation

This is typical for representing the distribution of percentages in the case of qualitative variables and is an alternative to the column diagram. This type of graph allows to establish in what relation the groups within the community are compared to the community as a whole.

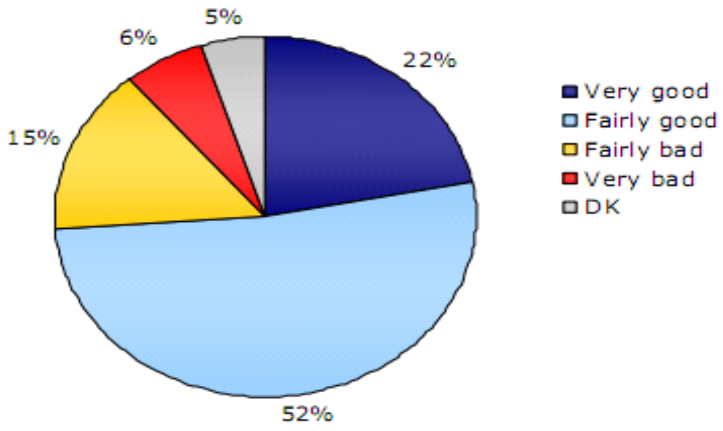

Fig. 5. Example of structural diagram

The characteristics of this diagram are:

• the total area represents 100% and 1% corresponds to 3.6 degrees;

• in the area of the circle write the percentages and not the degrees;

• the diagram is read in the clockwise direction starting with the point that can be associated with the 12 o'clock;

• the circle should not have more than 5-6 sectors;

• colors must be assigned from the darkest to the lightest;

• As this diagram provides an overview, the latter category must be "other" and color or color should not be dominant.

Ribbon diagram

The ribbon diagram is an alternative to the histogram. In this type of graph the rectangles are very narrow and they get the appearance of strips. The strips are horizontal. You can choose between numbers and percentages.

There are two ways to represent percentages:

• the percentages may be percentages of total men and separately percentages of total women;

• percent of the total population.

An example of a pie chart is the "pyramid of ages" ("pyramid population") - The age pyramid describes the population of a country or region by sex and age group. It consists of two horizontal histograms, one for men and one for women. Histograms are placed in the mirror to compare the sexes, in the population of a country / region. On the horizontal axis we can represent both absolute and percentage values.

The length of the bands is proportional to the values represented and their width is the same for all the bands.

The technique is used in other situations, for example:

• to represent the proportion of smokers in different age groups in men and women respectively

Statistical mapping

Statistical maps occupy a special place in representing spatial (geographical) variations of various phenomena or social health problems. Of these, in the health system the cartograms are used, which is a combination of the graph and the map.

Cartograms express the distribution of the levels of a phenomenon in a geographical area (country, districts, regions). Differences between proportions, rates, averages, etc., are easily highlighted by different coloration / shading of the geographical areas. It allows the comparison of the values between the different areas at the same time; the comparison highlights both the areas with the highest values and the areas with the lowest values. A spatial view of the information about the observing phenomenon is obtained.

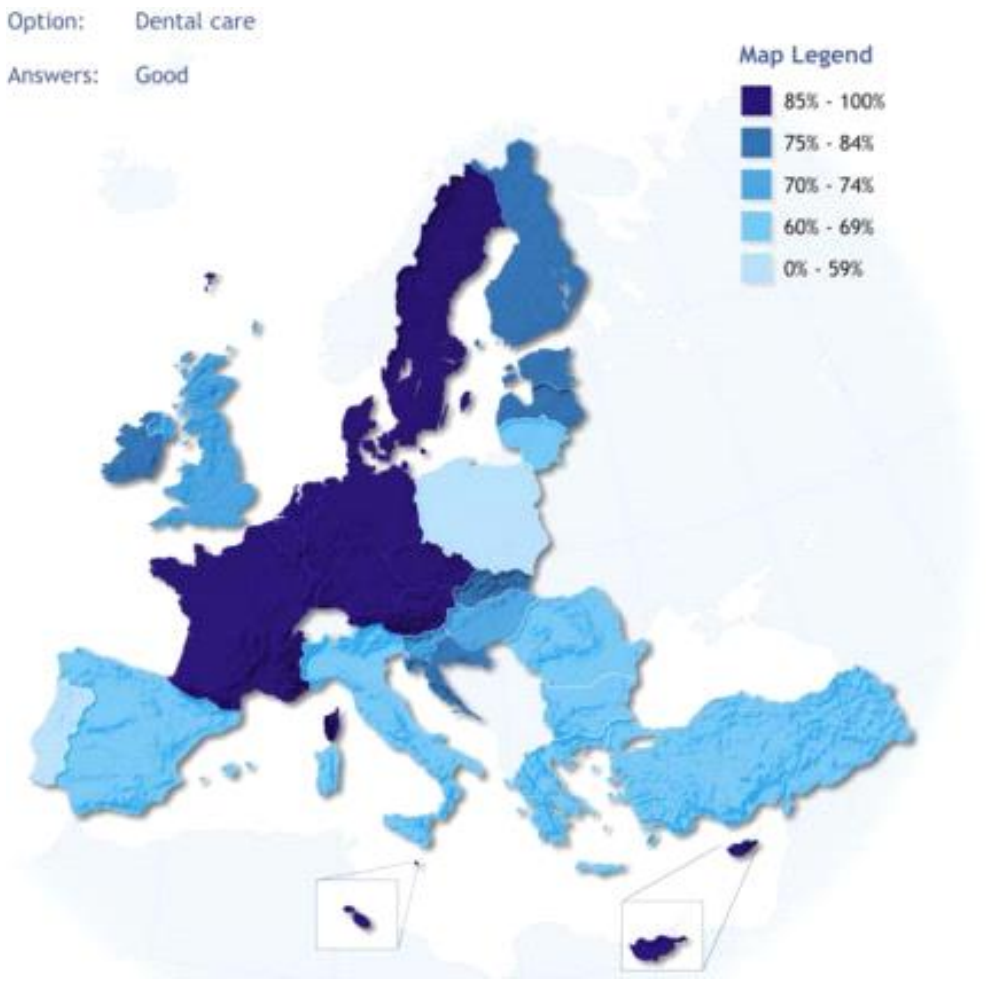

Fig. 6. Exemple of statitical map

In the technique of building a cartogram, the important steps are:

• the values of the observed phenomenon are grouped by size intervals;

• establish a color code or color scheme by which the values corresponding to each size range will be expressed;

• each area is colored or colored according to the group of values to which it belongs;

• the legend will explain the code used.

In the field of public health, the concept of HEGIS (Health Environment Geographic Information System) based on GIS (Geographic Information Systems) has been developed in recent years.

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