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REVIEW

Interpretation of statistical results☆

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Abstract The appropriate interpretation of the statistical results is crucial to understand the advances in medical science. The statistical tools allow us to transform the uncertainty and apparent chaos in nature to measurable parameters which are applicable to our clinical practice. The importance of understanding the meaning and actual extent of these instruments is essential for researchers, the funders of research and for professionals who require a permanent update based on good evidence and supports to decision making. Various aspects of the designs, results and statistical analysis are reviewed, trying to facilitate his comprehension from the basics to what is most common but no better understood, and bringing a constructive, non-exhaustive but realistic look.

PALABRAS CLAVE
Análisis estadístico;
Metodología;
Sesgo;
Interpretación errónea

Interpretación de resultados estadísticos

Resumen La interpretación de los resultados estadísticos es un elemento crucial para la comprensión de los avances en las ciencias médicas. Las herramientas que nos ofrece la estadística nos permiten transformar la incertidumbre y aparente caos de la naturaleza en parámetros medibles y aplicables a nuestra práctica clínica. La importancia de entender el significado y alcance real de estos instrumentos es fundamental para el investigador, para los financiadores de las investigaciones y para los profesionales que precisan de una actualización permanente basada en buena evidencia y ayudas a la toma de decisiones. Se repasan diversos aspectos de los diseños, resultados y análisis estadísticos, intentando facilitar su entendimiento desde lo más elemental a aquello que es más común pero no por ello mejor comprendido y aportar una mirada constructiva y realista, sin ser exhaustiva.

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Introduction

Clinical research is an indispensable means for the advancement of scientific knowledge and to implement it into the routine clinical practice in order to provide the patients with the best opportunities to recover or improve their health understood as years and quality of life.[1]

But to accomplish this we are going to need tools to be able to conduct research, describe the biological reality, facilitate the understanding of clinical research and allow manipulation through experiments in order to establish associations between stimuli (drugs, surgical technique, etc.) and interesting results.

Statistical techniques are mathematical models that require certain knowledge for their interpretation.[2,3] Without an adequate understanding, the generalization of the study results can be useless or dangerous. From an ethical point of view[4] making the effort of trying to understand is essential if we wish to be updated on scientific advances.[4] Also, given the huge scientific production available today fueled by the need for publishing to be promoted professionally, it is essential to know how to interpret statistical results in order to distinguish the important stuff from the unimportant one, develop an analytical spirit,[5] and assess any possible implications to our clinical and research practice.

The goal of this study is to provide a general standpoint on the interpretation of the most common statistical results and emphasize all limitations and potential errors (Table 1) for the adequate understanding of such results. Information can be more basic or more complex, not very thorough, but it is always necessary and will always be referenced to its use in the clinical research of the critically ill patient.

Summary statistics

Summary statistics allow us to visualize the characteristics of data distribution by synthesizing the dimension of a variable change, and they are basic concepts in statistics. The arithmetic mean is the sum of each value divided by the total number of individuals from a given population. It is affected by the existence of extreme values, so it is not appropriate for not very uniform distributions,[6] such as ICU stays. The trimmed mean eliminates extreme values, and the mode corresponds to the most common value within distribution; however, the utility of both is limited.

Variance is one indicator used to establish the degree of separation of one array (a dataset) with respect to its arithmetic mean, although we normally use the standard deviation (SD) as the square root of the variance expressed in the same units of the variable.[7] The SD shows the dispersion of distribution, being one SD above average usually indicative of asymmetrical distribution (when the number of cases is higher in high or low values, such as the ICU stay). If distribution is normal, it will show values where we find 68% ($\pm$1 SD), 95% ($\pm$2 SD), or 99.7% ($\pm$3 SD) of data. This is the origin of the popular expression mean $\pm$ SD although the term mean (SD) is preferred here.

When the distribution of the variable is asymmetrical we use measures based on order. The mean is the main value obtained after ordering the values. Quartiles, deciles or percentiles are the result of dividing the ordered sample into 4, 10, or 100 equal parts. The mean matches the 2nd quartile, the 5th decile, and the 50th percentile. In these cases, the preferred dispersion means are percentiles 25 and 75 or the difference between the two—called interquartile range (IQR). It is not the same as the range of a variable, indicative of the upper and lower limits of a variable. The ICU stay or the days on mechanical ventilation are values of asymmetrical distribution that we rather express using means and percentiles 25–75 or the IQR.[8]

Graphic representations

The distributions of the quantitative variables are usually represented through histograms (bar diagrams), or dispersion charts (scatter plot). Boxplots (Fig. 1) are highly indicative of the distribution of one variable. The box is limited from the bottom up by quartiles Q_1 and Q_3 with the mean at the center. The wings of the box contain even the lowest smaller value and the limit of Q_3 by at least 1.5 times the IQR. Values above this margin are remote values (above $Q_3 + 1.5 \times$ IQR) and extreme values (above $Q_3 + 3 \times$ IQR).

Prevalence and incidence

Prevalence is the proportion of cases of a given population showing a particular trait or disease. Prevalence can be point prevalence or period prevalence, when a time-lapse from t0 to t1 is analyzed and the population counted in the middle of an interval. The ENVIN-UCI registry studies are an example of the latter type of design.[9] Prevalence studies assess global trends and allow us to generate hypotheses, but not causal relationships.

Incidence is the number of new cases of a given disease or trait in a population throughout a period of time. Cumulative incidence is the proportion of patients at risk who are disease-free in a given period of time. The incidence rate (also called incidence density [ID]) is the number of new

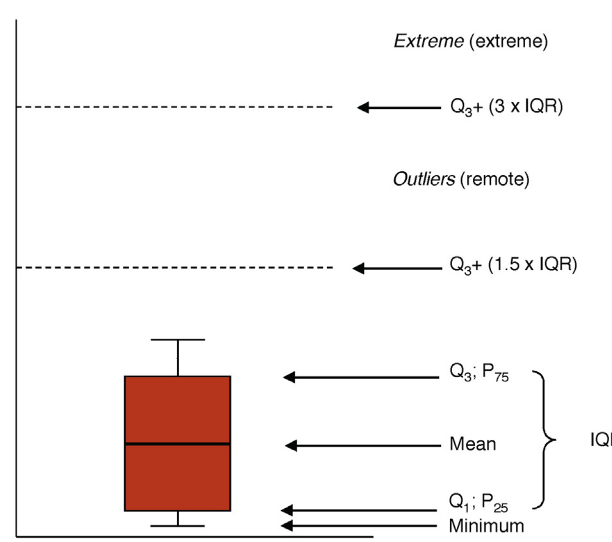

Figure 1 Representation of boxplot. Q_1: quartile 1 (equivalent to P_{25}: percentile 25); Q_3: quartile 3 (equivalent to P_{75}: percentile 75); IQR: interquartile range (difference between $Q_3 - Q_1$).