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Index for quality control in anthropometric surveys

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Abstract

In an anthropometric measurement process, there are many factors which are error sources even if the observers are highly trained. Systematic or bias errors are possible and they are not clearly noticeable. In this work we propose two simple and adimensional indices to use in the quality control of anthropometric surveys.

Such indices are applicable only to a few anthropometric variables but the results found by this control can be an indication of the quality of the complete measurement process. The indices are defined as

se = 100 × ((shoulder height − elbow height) − arm length)/(arm length)

and **ses** index is the same when the measures are obtained in sitting position. The observer must take those measurements again when the index values are higher than a selected threshold value before approving or rejecting the measure.

Relevance to industry

Anthropometric data are used in a wide variety of consumer products and in processes of industrial design. Wrong precision of data could cause problems in the industrial products. Those indices are useful to improve the accuracy and quality control of data.

Keywords: Anthropometry; Accuracy; Measurement quality control

1. Introduction

Generally, the accuracy and precision of research experimental devices are obviously known and the approximate true value of measures can be anticipated. Thus, the absolute and relative errors obtained for a measure are representative of the quality of the method and are used as a control of the complete measurement process.

On the other hand, statistical variables, e.g. standard deviation, are obtained as information of

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data variability. These values could be representative of the experimental sample's uniformity since the precision of measurement process is also previously known. Occasionally, they can be used as a measure of the experimental process quality.

When an individual value is really out of range, the possible causes are investigated. Only if the existence of a methodological mistake is proven, the value is rejected and the process is repeated correctly. It is a usual and simple quality control of the measuring process and the research methodology.

In some studies this is not possible to do. The observer cannot perceive the anomalous measures when the norm has a very wide range. That happens when the size differences among the subjects of a sample are much higher than the accuracy of experimental devices, sometimes a factor of 10 or higher. This is the case of anthropometric researches. In such studies, the direct and immediate quality control of the measurement process is easily missed.

To avoid this, many protocols are used to rise the degree of accuracy of the measures (Meunier and Yin, 2000), but there are many factors in human measurement that intervene as sources of error and results can be systematically different in spite of the observers being highly trained (Kemper and Pieters, 1974).

Thus, systematic or bias errors are possible and they are not clearly noticeable. Implicitly it is supposed that the standard deviations and variation coefficients are only representative of the population sample variability and that measure errors are negligible.

However, occasionally there are systematic errors in the measurement process, which could have a significant effect on both mean values of experimental variables and their standard deviations and could cause mistaken conclusions over different populations.

In this work we propose two adimensional indices to use in the quality control of the anthropometric measurement process. The observer must take those measurements again when the index values are higher than a selected threshold before approving or rejecting the value.

Such indices are applicable only to a few anthropometric variables but the results found by this control can be an indication of the quality of the complete measurement process.

2. Material and methods

We use the data obtained in a previous work about anthropometric variables (Lobato, 1997) over a randomised sample that involves 327 workers of the South East of Spain (202 men and 125 women), aged between 16 and 64 years. All variables are defined in accordance with the Norm ISO/DIS 7250.2 (1992) and EN/979 (1995).

From their definitions, we can derive that the measurements of shoulder height minus elbow height must be equal to shoulder–elbow length for each person, and we define the **se** index for standing position, similar to relative error definition, as

$$\mathbf{se} = 100 \times ((\text{shoulder height} - \text{elbow height}) - \text{arm length})/\text{arm length})$$

and **ses** index when measures are obtained in sitting position (Fig. 1).

We consider a valid measure when the indices **se** and **ses** are less than $\pm 7\%$ due to the normal distribution curve obtained (Fig. 2). These values are at the end of the tails of the curve. For subjects whose indices exceed the reference values, the measure must be taken again, taking great care over the results.

Those threshold values are chosen according to the sample size and experimental conditions of our anthropometric study. Thus, we obtained a confidence interval over 95%. Obviously, in different experimental conditions other limits can be used.

Such indices, **se** and **ses**, can be obtained in all cases for each subject, if possible, or for a population through the mean values. In this work measures are taken directly over subjects by the classic tapes and callipers and indices are calculated individually. It is also possible to use this quality control method in other measurement methods as 2D and 3D pictures; it is only necessary to know the algorithm variables.