Anthropometric study of the student population of a Portuguese faculty

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ABSTRACT: In recent years, there has been an increasing need of knowledge of the human population’s anthropometrics, particularly in Portugal. Changes in the anthropometric characteristics of the Portuguese people have been reported in some studies, leading to an increasing interest on the study of the evolution of these characteristics. This study aimed to collect and analyze the anthropometric dimensions of the student population of FEUP. For that purpose, a stationary anthropometer was built and a portable anthropometer was also used. Two hundred and six students (131 males and 75 females) with ages ranging from 18 to 35 years old, were measured. A set of 14 static anthropometric measures was collected. The results show significant differences in some anthropometric dimensions, when compared with studies performed by other authors, as well as between genders for almost all anthropometric dimensions.

1. INTRODUCTION

Ergonomics aims to fit the environment and the task, whether it is work or leisure, to the user so that they can work easily, effectively and safely (Mokdad & Al-Assar, 2009). This aim may be summarized by the principle of user-centered design. Pheasant & Haslegrave (2006) defined it as the fit of the design of an object, a system or an environment that are intended to human use to the physical and mental characteristics of its human users, as well as for the demand of the task.

One way of designing the task, based on the physical characteristics of the user, is doing it according to her/his anthropometric characteristics, such as body size (reach, body segment length, and height), shape (segment circumferences, widths), strength and working capacity (Barroso et al., 2005).

Until 2005, there was a lack of anthropometric data from the Portuguese population. Padez (2002) conducted a study which gathered data obtained by the army that measured the stature of the 18-year-old young men that went to military service. Later Barroso et al. (2005) measured a sample of the Portuguese population, creating the first anthropometric database of this population comprising 25 static anthropometric dimensions. Although the latter provides an accurate database, the student population of a university is, in its majority, much more narrow to young people (18 to 25 years old). Thereby, the use of this database would probably result in some error due to two main reasons: (1) its age range goes from 18 to 65 years old; (2) the time gap between the two studies. The first one reflects the accentuation of the spinal curvature in people with ages greater than 40 years old (Pheasant & Haslegrave, 2006) which results in a lowering of the people’s stature. The second reason may be supported by the expected change in some characteristics due to the secular trend (Azezes et al., 2006) that, accordingly to Padez (2002), estimated an increase of 9.9 mm per decade in Portuguese male stature, while other study suggested that the anthropometric databases should be updated every five years due to effects in the national anthropometric properties caused by regional altitude and climate, as well as sexual ones (Kaya et al., 2003).

The need for the anthropometric study of the Portuguese student population shows a relevant pertinence. Therefore, this paper aims to study the anthropometric dimensions for a sample of the Portuguese students of Faculty of Engineering of the University of Porto (FEUP).

2 METHODOLOGY

2.1 SUBJECTS

One hundred and thirty one men and 75 women from a universe of 7295 students were measured.
The sample was mostly composed by students from the integrated master programs, but also from undergraduate and master programs. With ages range between 18 and 35 years old, students were selected when passing through the hall of the building where most of the classes are taken.

2.2 Equipment used
Measurements were taken on a stationary anthropometer (Figure 1) built for the specific purpose of this study. Wood panels were arranged as a corner and covered with graph paper. To calibrate the anthropometer was used a self-retracting tape measure which insured the match of the lines of the paper with the lines of the measure. As aid to the measurements, grid lines were drawn every 100 mm and the corresponding value was marked.

For the collection of some anthropometric dimensions a portable anthropometer (Holtrain's Harpender anthropometer) was used. Those dimensions required postures that could influence the measurement. Therefore was used the portable anthropometer to ensure that the gathered data had the best accuracy and precision.

For the sitting measurements a bench was also used.

2.3 Procedure

2.3.1 Data collection
A total of 14 static anthropometric dimensions were measured for each individual. Six dimensions were measured with the individual standing, while the remaining were obtained while the individual was seated.

The anthropometric measures were taken with the subject in a relaxed and erect posture. Each student was measured in thin clothes (t-shirt, skirt or thin sweatshirt), jeans, skirts or dresses. The standing dimensions were taken with the student standing erect to the anthropometer without shoes. The sitting dimensions were taken with the student seated erect to the anthropometer, with knees bent 90°, and feet (without shoes) flat on the floor. The body dimensions were measured as described in ISO 7256-1:2008 (ISO, 2008).

The dimensions measured in both standing and sitting positions as well as the apparatus used for the measurements are detailed in Table 1.

2.3.2 Data treatment
First, Kolmogorov–Smirnov test was performed to study the normality of the anthropometric data's distribution. Then, mean and standard deviation were calculated for all the measured dimensions. Later, Student's t-test was used to test if the anthropometric dimensions of female and male populations were statistically different.

In order to measure data dispersion, the Coefficient of Variation (CV) was calculated as shown in equation 1:

\[
CV = \frac{s}{m} \times 100\% 
\]

where \( CV \) = Coefficient of Variation; \( s \) = standard deviation; and \( m \) = mean.

Table 1. Dimensions measured in standing and sitting positions.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Standing</th>
<th>Sitting</th>
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<tbody>
<tr>
<td>Abdominal depth*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbow–kneecap length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward grip reach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip breadth*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder breadth (bi-deltoid)*</td>
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<td>Statute</td>
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*Measured with the portable anthropometer.

3. RESULTS AND DISCUSSION

A great majority (84%) of the participants are younger than 25 years old (Table 2).

The sample used includes subjects from several lecture courses of FEUP, and several curricular years. This is reflected on the range of ages of the sample, 18–35 years. However, there is a predominance of younger students, 18–24 years. Accordingly to statistics from FEUP, the sample characteristics (age and female percentage) ensure the intended representativeness of the student population.

The coefficient of variation (CV) (Table 3) of this study was compared with the CV obtained in the previous study of Barroso et al. (2005) and with the characteristic value range of Pheasant & Haslegrave (2006).

Comparison between the results obtained and the previous study from Barroso et al. (2005) indicates a significant difference for the CV values in almost 80% of the anthropometric dimensions. It can be explained by the uneven sample size, which could be corrected by increasing the sample size. When compared with the characteristic ranges defined in Pheasant & Haslegrave (2006), lower CV was found in one anthropometric dimension (male and female stature). Nevertheless, about 70% of the dimensions are between the recommended ranges. Exceptions also occur with the values obtained for forward grip reach, hip breadth, popliteal height, thigh thickness and abdominal depth whose values are higher than the reference values by Pheasant & Haslegrave (2006). For the last two, a possible explanation can be the fact that these dimensions are associated with soft body tissue, particularly fat and muscle. Other possible explanation for the difference between them can be the fitness habits of the different people.

With regard to the other dimensions, explanation for the CV values found is possibly associated with the used for a larger sample.

Table 4 displays mean and standard deviation values for the 14 anthropometric dimensions measured in both genders, as well as the p-value obtained by Student's t-test. The results indicate that male have greater anthropometric dimensions, except for the hip breadth. In this case, there is no significant difference between both genders. This can be explained by the participant's young age, which bodies are still developing. The p-value for sitting elbow height was very close to the value of 0.05 but it was still below the significance level established. In all the other dimensions, males are bigger than females.

Table 6 compares the mean values for the male population, obtained in this study with the Portuguese population anthropometric database from Barroso et al. (2005), with British adults aged 19 to 25 (Pheasant & Haslegrave, 2006), with Malaysian adults aged 19 to 25 (Chong & Leong, 2011), and with Iranian adults aged 20 to 30 (Mouoodi, 1997).

The comparison between the results of the current study and the Portuguese anthropometric data...
by Barroso et al. (2005) shows a few differences, some of which are significant. For example, the stature has an increment of 61 mm in male and 55 mm in female. This difference may be related to three probable causes: (1) the age range of the sample once the spinal curvature increases above 40 years old (Pheasant & Haslehser, 2006); (2) the secular trend, which is known to occur in other studied populations (Pheasant & Haslehser, 2006), and was also observed in Portugal by Pague (2002); and (3) the provenience of the sample (university students that, due to different financial conditions, may adopt distinct diets).

As for the other populations, it might be observed that some differences exist, some of which are statistically significant. For instance, for stature, the highest differences found are those registered between the Portuguese and the Malaysian population, 38 and 65 mm for female and male populations, respectively. The contrast found in the anthropometric dimensions of the different populations highlights the usefulness of this study and of the presented results.

4 CONCLUSIONS

Fourteen body measurements of Portuguese university students were summarized in this paper and they enabled the anthropometric characterization of the Portuguese student population of FEUP. This can be used for the design of more ergonomic classroom and auditoria furniture.

The contrast between the data of this study and the data of the Portuguese adult anthropometric database emphasizes the need to extend the database, as well as its segmentation in age groups for more accurate use of that resource. One of the main limitations of this study is the sample size that, due to the lack of enough data, is smaller than would be recommended. That was reflected in the CV’s values observed.

Hopefully this study will become the necessary starting point for new studies in this field, particularly at a university level, as it enhances the anthropometric knowledge of the Portuguese young-adult students.

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REFERENCES


Pheasant & Haslehser (2006)