

# ANTHROPOMETRIC EVALUATION, STANDARDIZATION AND COMPARISON OF GARMENT SIZES

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**Abstract:** *The procedure and the structure of garment sizing is the method of classification of body shapes and incremental increase of sizes in the industrial garment production. The goal of standard garment sizing is to provide consistent and clear garment sizing and size labels offered to the customer and to adapt the corresponding segment adequately to the target population. Research performed for the purposes of this study can be perceived in a detailed explanation of the problems and standardization of garment sizing. A valuable contribution of this paper is an objective perception of the standardization of garment sizes. A comparison between garment sizes of the region, i.e. between Croatia and Hungary, is provided. Moreover, the characteristics and contribution of the Croatian Anthropometric System as an elementary basis for creating a new voluntary standard are given.*

**Keywords:** *anthropometric measurements, garment sizes, standardization*

## 1. Introduction

The group of visible and measurable features developed as a consequence of many genes and their interaction with different environment factors during the whole life of man determines body size and shape. These features are measured with a measurement scale, and within a population they vary within a continuous broad range [1]. The variability of anthropometric dimensions at population level is the subject of numerous scientific and professional studies in anthropology so that the results obtained by anthropometric measurements are used in different areas. In clothing and footwear manufacturing anthropometric measurements are used for construction and modeling, and they are performed on a representative sample of the specific population. A garment and footwear size system is obtained by a systematic anthropometric measurement of a population. A statistical analysis of the mentioned data provides data necessary for garment and footwear sizing of the population of the Republic of Croatia. The investigation was performed within the compound technological project *Croatian Anthropometric System (HAS)*, and the population of the Republic of Croatia were included because they are as consumers potential users of a voluntary garment and footwear size standard [2].

## 2. Significance of anthropometry

During child's growth characteristic changes happen, and the performance of anthropometric body measurements allows perceiving these changes which gradually occur in successive generations. From generation to generation children have become taller and earlier mature which is called secular trend. Over the last hundred years the average secular growth of body height in several West European countries and in USA has been about 1 cm per decade. As a period of a hundred years is too short for considerable genetic changes, the reasons for the secular trend mostly apply to the general improvement of food and health protection through control of infectious diseases by vaccination (particularly "children's diseases") and better medical care, improvement of housing conditions, reduction of the number of family members etc. Taking anthropometric measurements and their comparison with a specific period of time reveal changes in body dimensions, and their impact on health and life quality is investigated [1].

## 3. Standards

The determination of a target population of the compound technological project HAS results from the project goals which primarily consist of the determination of a garment sizing system and footwear for the population of the Republic of Croatia. Most countries define their standards according to their criteria so that size systems developed in individual European countries differ among each other. Most of these systems are based on the type of figure defined by body height and differences between chest girth, waist girth and hip girth. Garment sizes are mostly designated for two or three growth groups: short, medium and tall, and they are defined with three anthropometric measurements: chest, waist and hip measurement.

In the late 70-ties of the last century International Organization for Standardization - ISO adopted a series of standards which mean the beginning and basis for the unique garment and footwear size designation system around the world. By updating the standard ISO 3635 and issuing the standards ISO 8559 and ISO 9407 the foundations for a unique definition of human body measurements for the needs of garment and footwear industry were laid as well as for the method of conducting anthropometric measurements and the system of size designation for them. ISO officially started its work 23<sup>rd</sup> February 1947, and it was established as the organization of national organizations for standardization. Its task is to prepare, adopt and publish international standards and to take care of them.

The role of standardization in the textile and clothing industry has always been significant. The reason for this is that a greater part of the textile and clothing industry is oriented to export. European integration processes contribute to the integration of Croatian standards into ISO standards. The features of the basic actions of textile standardization and certification are:

- standardization of terminology
- standardization of technical characteristics of quality and limited deviations of raw materials, auxiliaries, products and semi finished products
- standardization of testing methods
- standardization of product labeling
- standardization of quality assurance system and
- standardization of certification system in the textile sector.

The textile technology develops with the aim to reduce high manufacturing costs, environmental pollution, energy and water consumption, whereby high creativity and flexibility of the production are retained. The following important conditions are to ensure delivery dates and high product quality, requiring a high living standard of today's man. Market has a great impact on the development of the textile and clothing industry, namely with requirements on quality and fashion trends concerning wear comfort as well as the growth of living standard and a high population growth. Textile production requires quality which causes the development of the textile industry, and new products, new technological processes, innovations in making textile machinery and increase in machine operating speed make their contribution. This reduces the number and size of faults, but it increases the operating speed and production safety. In addition to scientific research, it is necessary to research the market and to track the requirements for product quality in order to improve technology. A requirement emerges that quality is defined and the way of its evaluation and expression is determined. International quality standards are set which are to be fulfilled if success is striven for on the international market. Moreover, the manufacturers whose products will fulfill particular conditions will have a right to mark their product with the unique European conformity mark CE which will provide better product sales on the market [3].

#### **4. Relevance of defining garment sizes**

The relevance of defining garment sizes is noticeable in cases of launching textile products to different markets where customers because of not understanding the garment and footwear size designation get into a dilemma, and very often they do not know how to recognize size designation or it does not inform them qualitatively. It is often the case that even one product contains several similar labels. Customers can very rarely recognize the information which the garment label contains or which it does not provide because only experts can understand it. The above-mentioned indicates the need for finding a unique way of garment and footwear size designation which would be valid for all markets and provide clear information as well as potentially higher sales. As any other scientific method, anthropometry requires well defined procedures which can provide equal, accurate and reliable data which are comparable in different populations. Therefore, efforts have been made to standardize anthropometric instruments and measurement methods as well as to create a standard set of anthropometric variables.

There are no unique international size designation systems for clothing and footwear, because as a rule each country prescribes its own sizes on the basis of conducted anthropometric measurements. Measurements are mostly taken every ten to fifteen years on the basis of which standards are improved. It is necessary because of the conditions and way of life which are indirectly reflected on the measurements of human body.

On the basis of the prescribed standards the clothing and footwear industry manufactures and labels garments, and the consumers purchase them. It is in the interest of consumers and manufacturers that garments are manufactured according to specific standards and in as many sizes as possible. This way it is possible to meet wishes of a wider circle of unknown customers, this being the aspiration of each garment and footwear manufacturer. Hereinafter a graphical representation shows a size garment system based on the main body measurements found through the anthropometric study of a population. Fig 1 give an

overview of garment sizes of the Hungarian female population, whereas Fig. 2 give an overview of garment sizes of the Croatian female population [4].

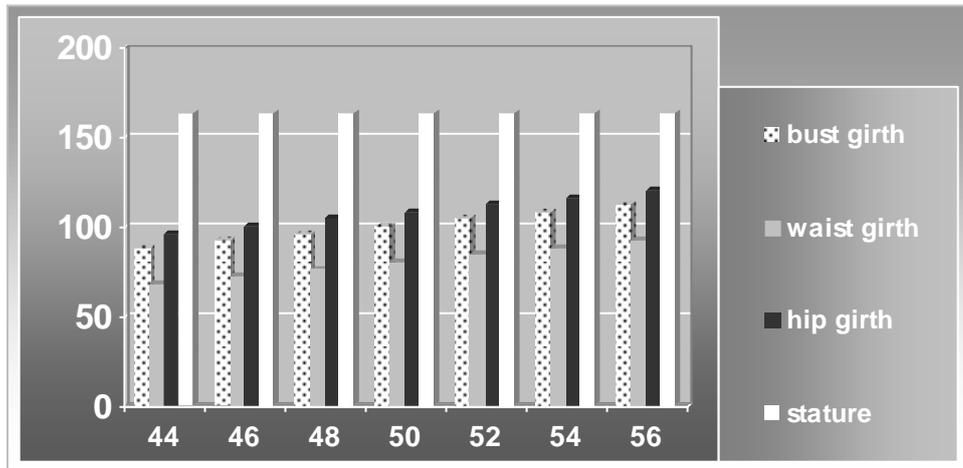


Figure 1: Garment size system of the Hungarian female population in cm [4]

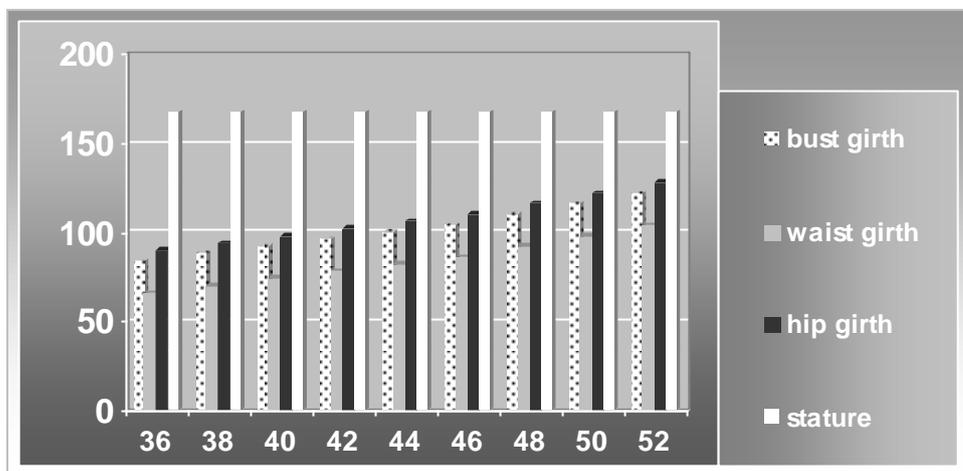
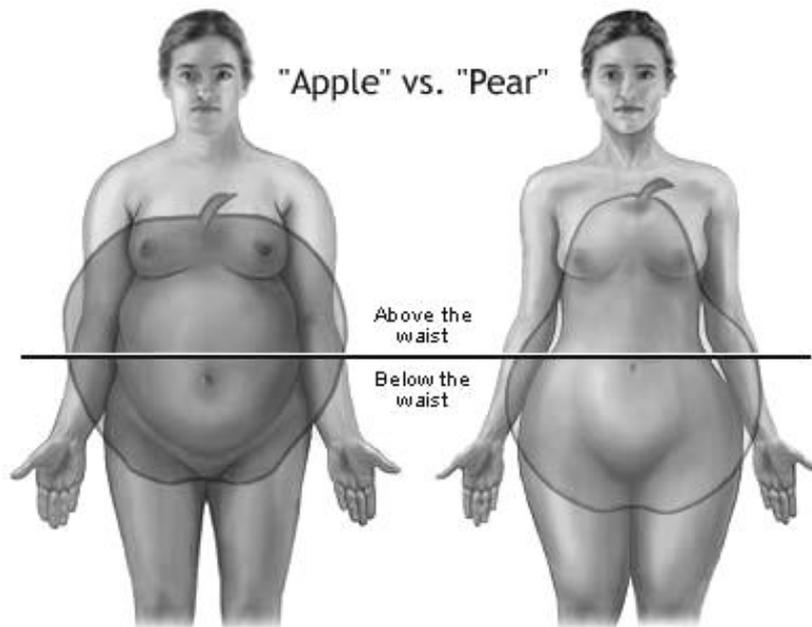


Figure 2: Garment size systems of the Croatian female population in cm [4]

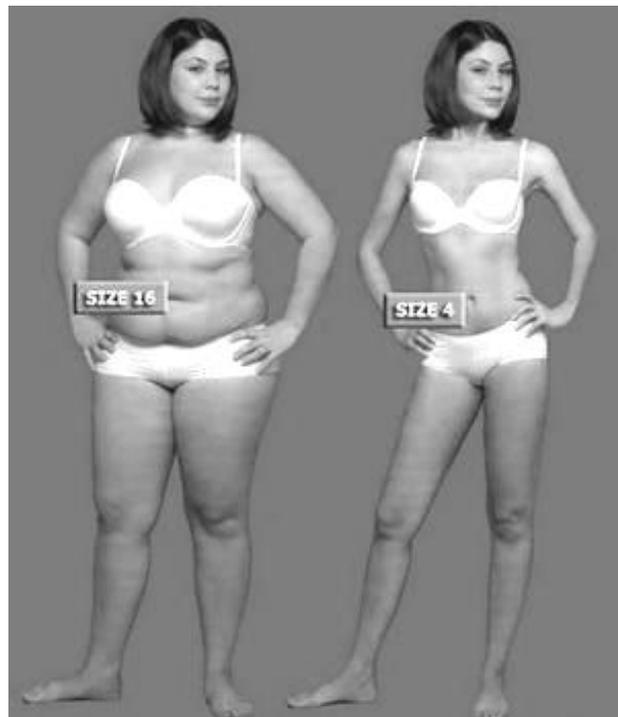
Based on the histograms shown in Figs. 1 and 2, similarities and differences in the main body measurements and the garment sizes of the female population in neighboring countries can be observed. The data was obtained by anthropometric studies, and they indicate that the female body dimensions of the Republic of Croatia and Hungary have some specific, but not too great differences. Garment size designations and the case that the garment size systems of the female population of the Republic of Croatia have one garment size smaller and one greater constitute a part of differences. This can lead to the conclusion that there is a greater diversity in female dimensions in Croatia in comparison to Hungary. The diagrams were created on the basis of the data of previous anthropometric studies [4].

Since people are quite different in stature and body development, it is necessary to study human body entirely. A large number of proportions is to be studied to make garment cuts. Proper mutual relationship among individual body parts or individual measurements can be established using proportions or relationships. On the basis of proportions body deviations from the average build or its deformation can be observed. Fig. 3 shows a female body depending on the distribution of fatty deposits. Apple shaped women incline to depositing fatty deposits in the waist region, while in pear shaped women fatty deposits are distributed in hip region [4].

Excess weight and depositing fatty deposits in the waist and hip regions mean a great problem because of increasing the number of obese people every day [5].



**Figure 3:** Apple and pear shaped female body [6]



**Figure 4:** Illustration of body dimensions for different garment sizes of the same body type [7]

## 5. Croatian Anthropometric System (CAS)

In the period between 2004 and the end of 2007 the anthropometric measurement of the population of all Croatian counties and in the city of Zagreb was taken within the scope of the project *Croatian Anthropometric System*. The entire implementation of the project was harmonized with the international standards ISO 8559, ISO 3635 and ISO 9407.

Measurements of anthropometric traits as well as data collection concerning sociological and economical conditions were performed by trained teams of measurers. The result of anthropometric measurements includes a total of 30,866 subjects in the Republic of Croatia or about 0.68% of the total number of inhabitants, resulting in the representation of individual garment and footwear sizes within the measured population and the entire population, respectively. This is exceptionally important to manufacturers so that

they could know the representation of a specific size in the total number of products, being one of the conditions for a successful product launch into the market.

Several tables have been created on the basis of the data obtained by the anthropometric measurement within the project *Croatian Anthropometric System*.

**Table 1:** Types of garments and measurements necessary to designate their sizes for men

Garments	Primary measurement	Secondary measurement	Secondary measurement
<b>Outer wear</b>			
<b>Men's jacket</b>	Chest girth	Waist girth	Stature
<b>Men's suit</b>	Chest girth	Waist girth	Stature, crotch length
<b>Trousers</b>	Wast girth	Stature	Crotch length
<b>Knitwear (T-shirts, cardigans)</b>	Chest girth	Stature	
<b>Shirts</b>	Neck girth	Stature	Sleeve length

**Table 2:** Standard measurements of waist girth per men's body types in cm

<b>Og</b>	84	88	92	96	100	104	108	112	116	120	126	132	138	144
Waist type <b>A</b> (very slim)														
<b>Os</b>	64	68	72	76	80	84	88	92	96	100	106	112	118	124
Waist type <b>B</b> (slim)														
<b>Os</b>	68	72	76	80	84	88	92	96	100	104	110	116	122	128
Waist type <b>C</b> (normal)														
<b>Os</b>	72	76	80	84	88	92	96	100	104	108	114	120	126	132
Waist type <b>D</b> (sturdy)														
<b>Os</b>	76	80	84	88	92	96	100	104	108	112	118	124	130	136
Waist type <b>E</b> (sturdier)														
<b>Os</b>	80	84	88	92	96	100	104	108	112	116	122	128	134	140
Waist type <b>F</b> (corpulent)														
<b>Os</b>	84	88	92	96	100	104	108	112	116	120	128	132	138	144
Waist type <b>G</b> (pot-bellied)														
<b>Os</b>	88	92	96	100	104	108	112	116	120	124	130	136	142	148
Waist type <b>H</b> (pronounced potbelly)														
<b>Os</b>	92	96	100	104	108	112	116	120	124	128	134	140	146	152
Waist type <b>I</b> (very pot-bellied)														
<b>Os</b>	96	100	104	108	112	116	120	124	128	132	138	144	150	156

Og - bust girth

Os - waist girth

In case of size designation of men's wear the most primary measurement is chest girth on which size designation of garments is based [8, 9].

## 6. Conclusion

The characteristics of the human body which determine its shape significantly differ among different populations, reflecting the adaptability of the body to the conditions of physical environment, food and diseases. Anthropometry plays a significant role in studying the evolutionary significance of differences in body dimensions and proportions present among the populations whose ancestors lived in different environmental conditions. The results of anthropometric measurements are used in a wide range of industries, from apparel industry, footwear industry to furniture industry. They are also used for making clothing sizes.

It is in the interest of consumers and producers that the clothes and shoes are made according to specific standards and as many sizes as possible. In this way the wishes of a large number of customers can be satisfied, and this is the aspiration of every manufacturer, especially in the clothing and footwear industry.

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