Development of Sizing System for Girls Aged 6 to 12 Years in Croatia

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A B S T R A C T

Garment size system is an important factor for both the adult population and the population of children and adolescents when choosing a suitable and fitting clothing. To develop the size system anthropometric measurements of selected population should be carried out. For this purpose a sample of girls aged 6 to 12 years in Croatia were measured (4002 respondents distributed proportionately to the total population). As the basis for a new method of garment size system, the system and method defined in the standards EN 13402 (1st–3rd part) were used. Using the method of cluster analysis three body types of girls was obtained. The new size system for girls will contribute to better production planning of fitting patterns and larger selection of garment sizes for more demanding youthful consumers.

Key words*: garment size system, cluster analysis, body type, girls, Croatia*

Introduction

A garment size system is essential for effective clothing design and production. Also it classifies a specific population into homogeneous subgroups based on some key body dimensions. Investigated persons of the same subgroup have the same body shape characteristics and share the same garment size[1].

During the past fifty or so years there have been many anthropometric surveys directed towards providing information for the sizing of children's, women's and men's clothes and in some countries these surveys are repeated at regular intervals in order to revise and improve current sizing systems.

Other than some small scale surveys carried out by the medical professions, the first major survey into children's sizes and measurements was performed by the textile and clothing division of the USA Department of Agriculture between 1937 and 1939. The objective of the survey was to supply accurate measurements for use in the construction and grading of children's patterns so as to bring a greater measure of uniformity among the manufacturers of children's clothes in the USA[2]. During a period of two and a half years, over 147.000 children between the ages of 4 and 17 years were measured, with at least 36 measurements including weight being taken of each child. After all the raw data had been analysed, a

sizing system was developed based on height and hip girth. The report of this survey was first published in 1941 and it was a landmark in the development of sizing systems for children's clothes[2,3]. Since then many other countries have carried out similar surveys which produces a firm proposal for a sizing system.

As a result of anthropometric measurements the share of individual garment sizes in the population being measured will be obtained. It is very important for manufacturers to know the share of a certain size in the total number of products because they work for unknown customers, being one of the conditions for successful sales in the market. Consumers are able to buy articles of clothing of appropriate sizes[4,5].

Most countries establish standards for size systems according to certain criteria. In sizing systems for children's and infant's wear, age is a common indicator used in conjunction with others, such as body mass and height, but clothing is often designated by age alone. It can be regarded at best as only a rough guide to the body size, and the dual designation of age and mass is only a slight advance so far as sizing is concerned, for neither gives a direct indication of body dimensions or body shape on which the garment fit depends. The irrelevance of age as a body size indicator can best be illustrated graphically

as shown in Figure 1 where the three girls are 8 years old[6]. Figure shows difference in body shapes and sizes. Although growth of children is too complex to be described by a simple measurement, body height is usually the only parameter used in the assessment of changes in linear body dimensionality[7]. Anthropometric data show that the heights of 8 year old girls can vary from 103 to 127 cm providing a range of 24 cm of the same age. A French report testifies to this variability among children, for a height of 138 cm there are girls between the ages of 7 and 15 years; and yet, to this day, children's wear is sized by age in some of the advanced countries of the world[6].

For the purposes of the sizing of clothes, all children are best grouped into infants, boys, and girls, the dividing line being arbitrarily drawn between the first and the two others at the height value of 104 cm. This tri-partite division is suggested partly for purposes of simplicity and partly due to the well-known fact that the members of each group have different growth rates and growth features. Total body height is clearly of primary importance for all growing children for clothes-fitting purposes and this has been justly recognized by TC 133 and in many national standards. The Swedish »Centilong« System, based on height values, is now used in a number of European countries[6]. Depending on the type and style of clothing concerned for girls' wear requirement measurements are: bust, waist and hip girth and also arm length and outside leg length (trousers length in this investigation).

The above measurements, according to the type of clothing and importance, are divided into primary and secondary in order to better define the shape of the body[6,8,9]. In the Croatian clothing industry, until recently, the former system (JUS) still applied as Croatian standards (HRN) were used. This particular standards dating back to the 70-ties of the last century, in the meantime, are supplemented and modified so that there is doubt to their validity. In February 2012 the Croatian Technical Report (HRI 1148:2012) entitled »Anthropometric System – Measuring and Size Designation of Clothes and Footwear« was published. The report includes specifics
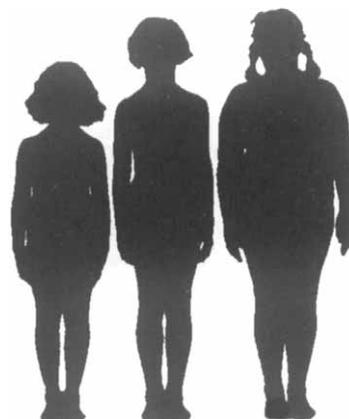
Fig. 1. Three eight years old girls[3,6].

of body measurements of the Croatian population (children, women and men) and relies on existing European standards[10]. According to HRN standards, size system for the female children outerwear is made on the basis of body height and age, and does not include body type. Body height for girls ranges in the interval from 86 cm to 166 cm, which also corresponds to the body height of the child aged 2 to 16 years. Range of the marked body height is 6 cm to body height of 158 cm, and 4 cm to body height of 166 cm at age of 16[11,12] (Table 1).

Various methods of sizing system development

With the difference in body dimensions and morphological characteristics, different body shapes can be generalized to a few figure types[1,13]. Figure type plays a decisive role in a sizing system and contributes to the issue of fit. Emanuel et al. recommended the use of the difference in figure types as the classification of ready-to-wears, and developed a set of procedures to formulate standard sizes for all figure types[1,14]. In early times, the classification of figure types was based on body weight and body height. Later on, anthropometric dimensions were applied for classification. Based on this method, a linear structure was found in many of the commonly used sizing systems,

TABLE 1
SIZE SYSTEM FOR A FEMALE CHILD OUTERWEAR ACCORDING TO JUS/HRN, WITH ASSOCIATED MAIN BODY MEASUREMENTS

Clothing size	2/86	3/92	4/98	5/104	6/110	7/116	8/122	9/128
Body height (cm)	86	92	98	104	110	116	122	128
Bust girth (cm)	54	56	58	60	62	64	66	68
Waist girth (cm)	54	56	57	58	59	60	61	62
Hip girth (cm)	58	60	62	64	66	68	70	72

Clothing size	10/134	11/140	12/146	13/152	14/158	15/162	16/166	
Body height (cm)	134	140	146	152	158	162	166	
Bust girth (cm)	70	72	76	80	84	88	92	
Waist girth (cm)	63	64	65	66	67	68	69	
Hip girth (cm)	74	78	82	86	90	94	98	

such as KS K 0050 and JIS L 4002. This type of sizing system has the advantages of easy grading and size labelling. But, the disadvantage is that the structural constraints in the linear system may result in a loose fit. Thus, some optimization methods have been proposed to generate a better fit sizing system, such as an integer programming approach[1,15–17] as experienced method and a nonlinear programming approach[1,18]. For the development of sizing systems using optimization methods, the structure of the sizing systems tends to affect the predefined constraints and objectives. Probability of purchase depended on the distance between the sizing system of a clothing and the real size of an individual[1,16]. In order to optimize the number of sizes so as to minimize the distance, an integer programming approach was applied to choose the optimal sizes. Later on a sizing system by using a nonlinear optimization approach to maximize the quality of fit was constructed[18]. Recently, Gupta et al. used a linear programming approach to classify the size groups[1,19]. Furthermore, data mining techniques such as cluster analysis[1,20–23], neural networks[24–26] and the decision tree approach[27,28] have been applied to develop garment sizing systems. Cluster analysis was used as an exploratory data analysis tool for classification. A cluster which is typically grouped by the similarity of its members' body shape can be considered as a size category or a figure type.

About 26% of the world populations are children (under the age of 15 years)[29]. For children's sizing systems, the related studies are rare because of its complexity and lack of up-to-date anthropometric data. Age and gender are the two important factors affecting children's body shape characteristics. Girls start to grow between the ages of 8 and 12 years and reach puberty about 2 years earlier than boys. During the growth period, there is a rapid change in body proportion, and the segmental relations of children have more variations than adults. This issue can be addressed if we include more body dimensions to describe figure types. Among all the sizing systems for children, only a few were developed by classifying figure types. Many sizing systems for children were developed by referring to the adult's sizing systems. If we neglect the fact that children's figure types have much more variations than adults, there will be a fit problem. For example, using the drop value (the difference between chest girth and hip girth) is a popular method to classify figure types for adults, but it is not suitable for classifying figure types for children during the growing period, because the girth difference for children is not so obvious. Thus, it is necessary to consider the body's dimensional characteristics in each growing period to establish the corresponding sizing system[1].

Material and Methods

Subjects

This study was conducted on 4002 girls aged 6 to 12 years. The sample was proportionally represented according to the number of inhabitants in Croatia. Also the

investigation was conducted within the comprehensive technology STIRP-project entitled »Croatian Anthropometric System« and scientific project »Anthropometric Measurements and Adaptation of the Garment Size System«. Subjects were classified in one year age groups.

Methods

According to described sample 12 anthropometric measurements for girls (body height, bust girth, waist girth, hip girth, knee height, crotch length, seat depth, trousers length, upper leg girth, knee girth, lower leg girth and ankle joint girth) were taken. Sizes for measurement were selected on the basis of the measurements necessary to determine the body types for garment for the lower body. The International Organization for Standardization (ISO) issued, as a recommendation, a series of standards towards the end of the 70-ties of the last century, constituting the basis of the unique system of designation clothing and footwear all over the world. At a later time by issuing ISO 3635, ISO 8559 and ISO 9407 standards, the foundations of defining the human body for the purposes of the clothing and footwear industry as well as for the implementation of anthropometric measurements were laid[4,5,8,30–36]. This system is used to define the garment sizes and shows morphological features, and provides insight into the development characteristics and health status of certain population[30].

Basic anthropometric instruments for taking measurements are measuring tape, one-arm and/or two-arm anthropometer and caliper[4,5,31,37–41].

Statistics

Descriptive statistics was used to present substantial characteristics of the data. Differences between age groups were tested using t-test for independent samples, i. e. one way analysis of variance. Correlation between body measurements using Pearson correlation coefficient was tested[42,43].

The structure of the variables was analyzed using principal components analysis method and to facilitate the determination of their content varimax rotation was used. The main components in this investigation served to verify the method of creating a sizing system. They are based on the categorization of body height, bust girth and waist girth. The structure of the subjects was examined with K-mean cluster analysis method, which was conducted in order to determine the body types. The number of clusters was limited to three because more than three body types would produce unacceptably large number of possible garment sizes[44,45]. Description and analysis of data was performed in Statistica software[46] and SPSS with the help of literature[47,48].

Results and Discussion

The description of the main body measurements showing their distribution, with the corresponding normal distribution by age was derived. The same body

Body measure-ment (cm)	Age	N	$\overline{X}$	SD	CV	95% CI		Range	
						h_1	h_2	Min	Max
Body height	6	521	119.9	6.1	5.1	119.4	120.4	102.0	141.0
	7	599	126.0	6.5	5.2	125.5	126.5	101.0	150.1
	8	628	130.9	6.6	5.0	130.4	131.4	115.5	149.0
	9	653	136.3	7.0	5.2	135.8	136.9	118.0	160.0
	10	577	142.1	7.9	5.6	141.4	142.7	115.3	172.2
	11	518	148.9	7.9	5.3	148.2	149.6	129.0	178.0
	12	506	154.9	8.0	5.2	154.2	155.6	129.0	180.0
Bust girth	6	521	58.7	4.4	7.5	58.3	59.1	47.5	76.0
	7	599	60.6	5.4	8.9	60.1	61.0	50.0	83.0
	8	628	63.1	5.9	9.4	62.6	63.6	49.0	92.0
	9	653	66.2	7.4	11.2	65.7	66.8	48.0	96.0
	10	577	68.5	8.1	11.9	67.9	69.2	49.0	100.0
	11	518	72.9	8.2	11.3	72.2	73.6	53.0	104.0
	12	506	76.2	7.9	10.4	75.5	76.9	61.0	108.0
Waist girth	6	521	55.6	5.3	9.6	55.1	56.1	43.0	78.0
	7	599	56.9	6.1	10.7	56.4	57.4	43.0	81.5
	8	628	58.5	6.9	11.8	58.0	59.1	42.0	90.0
	9	653	61.1	7.7	12.6	60.5	61.7	43.0	90.0
	10	577	62.2	8.1	13.0	61.6	62.9	47.5	93.5
	11	518	64.7	7.9	12.2	64.1	65.4	49.0	96.0
	12	506	66.4	7.6	11.4	65.8	67.1	50.0	99.0
Hip girth	6	521	64.3	5.3	8.3	63.8	64.7	49.0	82.0
	7	599	66.8	7.1	10.6	66.2	67.3	47.0	91.0
	8	628	70.4	7.2	10.2	69.8	70.9	45.0	99.0
	9	653	74.1	7.8	10.5	73.5	74.7	58.0	101.0
	10	577	76.6	8.3	10.9	75.9	77.3	52.0	104.0
	11	518	80.7	7.6	9.5	80.0	81.3	61.0	105.5
	12	506	84.4	8.1	9.6	83.7	85.1	64.0	117.0

height proved to be normally distributed in all age groups. The distribution of the analyzed body measurements was tested for normality with the Kolmogorov-Smirnov test. Evaluation of the basic parameters of the distribution of the measurements is presented in Table 2. Dispersion of body measurements measured by the coefficient of variation (CV) is equal in every age group. The CV of body height is between 5 and 6% in all age groups. It is similar with girths, with difference, that in all age groups they vary about twice as much as body height.

Thus, the CV of the bust girth ranges from approximately 7 to 12% and the CV of waist girth and hip girth one percent higher. Girls aged 6 to 12 years grow up about 35 cm, bust girth has increased 15.5 cm, waist girth 10.8 cm and hip girth 20.1 cm. Given the acceptable variability and normal or acceptable normal distribution of main body measurements they are considered to be suitable for further statistical analysis[49].

Analysis of the latent structure of body measurements

The analysis was performed using 12 body measurements to determine the sizes of the lower body for girls aged 6 to 12 years. According to the Kaiser-Meyer-Olkin criterion of adequacy (KMO) and Bartlett's test of sphericity all analyzed groups are suitable for the application of the principal component analysis (PCA) with the aim of replacing the corresponding manifest latent space with fewer dimensions (Table 3). PCA of girls by age groups has highlighted the fact that their latent structure exhausts the two main components, the first represents body girths and the second longitudinal measurements with different behavior of seat depth and ankle joint girth. For this reason it is advisable to carry out an analysis of the latent structure together for girls of all ages. The adequacy of the solutions to both adequacy criteria is not in question in all age groups. The resulting

TABLE 3
RESULTS OF KMO AND BARTLETT'S TEST OF SPHERICITY

Age (years)	Sampling adequacy (KMO)	Number of factor extracted (PCA)	Factor	Scree plot criterion	Bartlett's test
6–12	0.952	3	Factor 1 Factor 2	2 components	p<0.001

TABLE 4
BASIC PARAMETERS OF THE DISTRIBUTION OF THE MAIN BODY MEASUREMENTS BY CLUSTERS

Body measurement (cm)	Cluster	N	$\overline{\mathrm{X}}$	SD	CV (%)	95% CI		Range	
						h_1	h_2	Min	Max
Body height	Small	1430	123.2	5.9	4.8	122.9	123.5	101.0	138.0
	Medium	1624	138.3	5.9	4.3	138.0	138.6	121.0	154.2
	Big	948	153.9	7.5	4.9	153.4	154.4	130.0	180.0
Bust girth	Small	1430	58.8	3.5	5.9	58.7	59.0	47.5	73.0
	Medium	1624	65.9	4.6	7.0	65.7	66.1	53.0	83.0
	Big	948	78.5	7.2	9.1	78.0	79.0	64.0	108.0
Waist girth	Small	1430	55.1	4.5	8.1	54.8	55.3	42.0	74.0
	Medium	1624	60.4	5.5	9.1	60.2	60.7	47.5	83.0
	Big	948	69.5	7.9	11.4	69.0	70.0	54.5	99.0
Hip girth	Small	1430	64.6	4.7	7.2	64.4	64.8	45.0	81.0
	Medium	1624	74.1	5.1	6.9	73.9	74.4	60.0	93.0
	Big	948	86.5	6.7	7.7	86.1	86.9	71.5	117.0

solution for a group of girls aged 6 to 12 years is certain synthesis of solutions by age groups. It contains two main components: the first explains 43.4%, second 38.5%, and together they explain more than satisfactory 81.9% of the total variability. According to the values of communality all variables are well represented except seat depth. The investigation of the latent structure of body measurements for girls shows that they are largely determined by girth measurements and then by longitudinal measurements. It proves current practice that garment size systems are primarily tied to classify by bust girth (if necessary, by waist and hip girth) and then by body height[49].

Cluster analysis

The objective of cluster analysis is to segment the sample population into homogenous groups which apply the non-hierarchical K-means cluster method[49]. For technological reasons, it was decided to extract three clusters as possible representatives of basic body types. For the initial cluster centers the first three subjects from the data files were selected.

The first cluster has 1430 girls, the second 1624 girls and third 948 girls. Properties of the clusters are described with descriptive statistics (as shown in Table 4).

Average values of body measurements in clusters indicate that girls are grouped as the reflection of age changes such as growth (refer to Figure 2). For this rea-

son, clusters are designated as »small« (M), »medium« (S) and »large« (V). Younger age groups (6 and 7 years) are M cluster, groups of 8, 9 and 10 years are S cluster, and girls aged 11 and 12 years are V cluster[49].

Proposal of garment size system

An effective sizing system should have fewer sizes, higher coverage of the population and better fit[18,49]. Re-
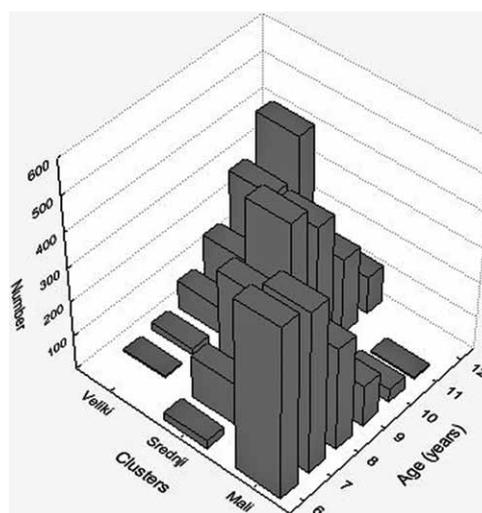
Fig. 2. The frequency of girls by clusters and age.

TABLE 5
SIZE DESIGNATION SYSTEM FOR LOWER BODY FOR GIRLS

Body type		Body measurement (cm)								
Cluster 1 Small (M)	Body height	118	118	118	118	118	124	124	124	124
	Waist girth	51	53	55	57	59	50	51	53	55
Cluster 2 Medium (S)	Body height	130	136	136	136	136	136	136	136	142
	Waist girth	63	53	55	57	59	61	63	65	53
Cluster 3 Big (V)	Body height	148	148	148	154	154	154	154	154	154
	Waist girth	65	67	69	59	61	63	65	67	69

Body type		Body measurement (cm)							
Cluster 1 Small (M)	Body height	124	124	124	124	130	130	130	130
	Waist girth	57	59	61	63	51	53	55	57
Cluster 2 Medium (S)	Body height	142	142	142	142	142	142	148	148
	Waist girth	55	57	59	61	63	65	57	59
Cluster 3 Big (V)	Body height	154	160	160	160	160	160	160	166
	Waist girth	71	59	61	63	65	67	69	67

garding to that it is necessary to determine the exact percent and number of garment sizes.

As the basis for a new method of identifying garment sizes for girls the system and method of identification defined in the standards EN 13402 were used[8,49]. There are two types of control measurements that define the size of the clothes: primary or basic measurements and one or more secondary measurements. In size designation for girls primary measurement is body height. That is so because the children in their development show very large differences in body height at the same age. As mentioned before girls are grouped into clusters that reflect the body height. Range of body height, bust girth and waist girth were selected within 2.5[th] and 97.5[th] percentile. For

Fig. 3. Clothing sizes for lower body according to body type.

the lower body primary designation measurement is body height and secondary is waist girth. Possible garment sizes that describe the lower body are listed in Table 5. Garment sizes are divided by clusters and include the population of girls between 5th and 95th percentile. It was found 19 garment sizes for each size group[49].

Frequency of garment sizes for lower body for girls

Garment sizes for the lower body for girls are shown in Figure 3. The size interval for body height is 6 cm and for waist girth is 1 and 2 cm. Body height constitutes 10 height classes with an interval of 6 cm. Frequency of garment sizes for the lower body is presented in Table 6. The total number of girls in the group is 1343. Size system contains 18 garment sizes from approximately 2% of the population involved covering 80.3% of the population of girls. The most common garment sizes are the ones that include body height of 118 and 124 cm, and the values of waist girth of 51, 53 and 55 cm. The percent of these combinations ranges from 5.1% to 7.7% for garment size M/124/51. Garment size M/130/59 belongs to the S type of girls.

In Table 7 are given the frequencies of garment sizes for the lower body and the number of subjects (1620). Garment sizes S/130/55 and S/130/57 are not included in this group, as these already exist in the M type with greater frequency. It was selected 19 garment sizes from approximately 2% of the population which covers 67.1% of girls. Garment sizes that include body height of 136 and 142 cm, and waist girth of 57, 59 and 63 cm are most common.

Frequency of garment sizes for the lower body of V type and their individual number are listed in Table 8. In total, in the above group is 900 girls, but not all groups are shown due to the small size frequency. Number of
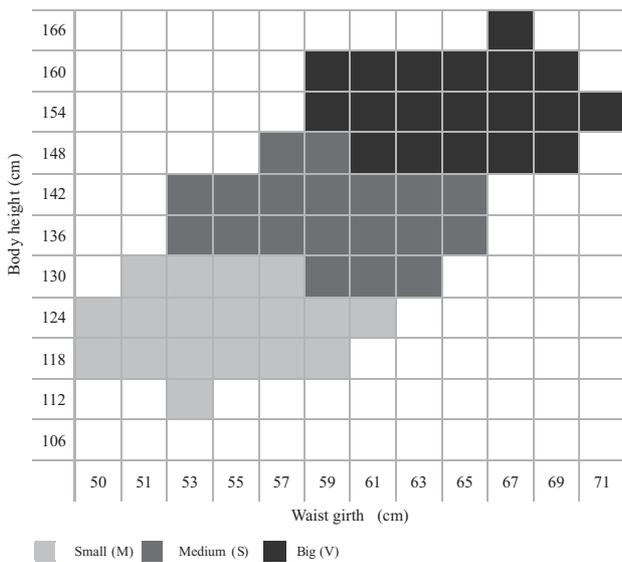
TABLE 6
FREQUENCY OF CLOTHING SIZES FOR LOWER BODY FOR SMALL TYPE OF GIRLS

Body height		Waist girth									
		49	50	51	53	55	57	59	61	63	65
136	N	3	2	3	5	5	3	2	1	1	
	%	0.2%	0.1%	0.2%	0.4%	0.4%	0.2%	0.1%	0.1%	0.1%	
130	N	9	12	45	63	77	56	30	12	6	3
	%	0.7%	0.9%	3.4%	4.7%	5.7%	4.2%	2.2%	0.9%	0.4%	0.2%
124	N	10	26	104	99	91	72	69	37	20	9
	%	0.7%	1.9%	7.7%	7.4%	6.8%	5.4%	5.1%	2.8%	1.5%	0.7%
118	N	5	34	70	69	72	43	25	13	6	1
	%	0.4%	2.5%	5.2%	5.1%	5.4%	3.2%	1.9%	1.0%	0.4%	0.1%
112	N	4	14	23	27	15	7	5		2	
	%	0.3%	1.0%	1.7%	2.0%	1.1%	0.5%	0.4%		0.1%	

TABLE 7
FREQUENCY OF CLOTHING SIZES FOR LOWER BODY OF MEDIUM TYPE OF GIRLS

Body height		Waist girth									
		51	53	55	57	59	61	63	65	67	69
154	N	1	1	3	7	2	2	1	2		
	%	0.1%	0.1%	0.2%	0.4%	0.1%	0.1%	0.1%	0.1%		
148	N	6	20	24	33	58	28	20	10	1	2
	%	0.4%	1.2%	1.5%	2.0%	3.6%	1.7%	1.2%	0.6%	0.1%	0.1%
142	N	13	40	49	70	78	67	65	40	13	12
	%	0.8%	2.5%	3.0%	4.3%	4.8%	4.1%	4.0%	2.5%	0.8%	0.7%
136	N	18	59	69	85	98	58	74	31	19	24
	%	1.1%	3.6%	4.3%	5.2%	6.0%	3.6%	4.6%	1.9%	1.2%	1.5%
130	N	10	25	38	46	51	32	30	19	14	12
	%	0.6%	1.5%	2.3%	2.8%	3.1%	2.0%	1.9%	1.2%	0.9%	0.7%
124	N				2	3	4	2	1	6	6
	%				0.1%	0.2%	0.2%	0.1%	0.1%	0.4%	0.4%

TABLE 8
FREQUENCY OF CLOTHING SIZES FOR LOWER BODY OF BIG TYPE OF GIRLS

Body height		Waist girth								
		57	59	61	63	65	67	69	71	73
166	N	1	6	6	11	11	14	12	6	3
	%	0.1%	0.7%	0.7%	1.2%	1.2%	1.6%	1.3%	0.7%	0.3%
160	N	5	24	18	24	17	20	25	13	10
	%	0.6%	2.7%	2.0%	2.7%	1.9%	2.2%	2.8%	1.4%	1.1%
154	N	14	23	31	40	43	32	36	23	13
	%	1.6%	2.6%	3.4%	4.4%	4.8%	3.6%	4.0%	2.6%	1.4%
148	N	5	14	31	27	24	17	26	16	14
	%	0.6%	1.6%	3.4%	3.0%	2.7%	1.9%	2.9%	1.8%	1.6%
142	N			1	3	5	10	9	9	9
	%			0.1%	0.3%	0.6%	1.1%	1.0%	1.0%	1.0%

garment sizes is 19, with approximately 2% of the population involved (67.3% girls[49]). The most common garment size is V/154/65.

Conclusion

On the basis of the study of Croatian girls the most obvious are age-related changes in body height. Correlation coefficients of body height with individual girths are important and significant in all age groups. Investigation of the latent structure of body measurements shows greater determination of measurements by girths and then by lengths.

Also, this is the first established sizing system for girls clothing in Croatia based on the anthropometric data using data mining technique. Using clustering data mining, the girls were segmented into three clusters as possible representatives of basic body types. That established a new garment size system by defining a larger number of body measurements according to body height groups. Sizing system of 57 garment sizes for the lower body (the system suitable for trousers and skirts) for a group of girls was established.

Conducted investigation of anthropometric measurements of Croatian girls shows different morphological dimension in today's generation from those of 50 years ago, on which garment sizing systems were based.

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RAZVOJ SUSTAVA VELIČINA ODJEĆE ZA DJEVOJČICE DOBI OD 6 DO 12 GODINA U HRVATSKOJ

S A Ž E T A K

Prilikom odabira prikladne i pristale odjeće sustav veličina odjeće važan je čimbenik, kako za odraslu populaciju tako i za populaciju djece i mladeži. Da bi razvoj sustava bio moguć potrebno je provesti antropometrijska mjerenja odabrane populacije. U tu svrhu izmjeren je uzorak djevojčica dobi od 6 do 12 godina na području Hrvatske (4002 ispitanice proporcionalno raspoređene prema ukupnom broju stanovnika). Kao temelj za novi način označavanja odjevnih veličina koristio se sustav i način označavanja definiran u normama HRN EN 13402 (1.-3. dio). Upotrebom metode klaster analize dobivena su tri tipa tijela djevojčica prema građi tijela. Novi sustav veličina za djevojčice pridonijet će boljem planiranju proizvodnje, pristalijim krojevima odjeće te većem izboru odjevnih veličina za sve zahtjevnije mladenačke potrošače.