

Determination of Measurements of the Female Population of the Republic of Kazakhstan

Tavarkul Aljanovna Baskimbayeva¹ & Yerkin Dhumahanovich Danebergenov¹

¹ Almaty Technological University, Almaty, Kazakhstan

Correspondence: Tavarkul Aljanovna Baskimbayeva, Almaty Technological University, Almaty, 050012, Kazakhstan.

Received: November 27, 2014

Accepted: December 3, 2014

Online Published: May 30, 2015

doi:10.5539/mas.v9n6p234

URL: <http://dx.doi.org/10.5539/mas.v9n6p234>

Abstract

Article deals with the problem of the size typology development of the female population of the Republic of Kazakhstan. Based on the statistical data of anthropometric measurements of the female population the absolute values of the basic dimensional characteristics for four age groups are determined. Based on the correlative-regression analysis the dependences of subordinate measurements from the leading were revealed. The analysis of the numerical values of the measurements of the female population depending on the age factor is given. On the basis of the calculation of the regression equations, the values of dimensional attributes of subordinates for typical figures used in the design of clothing are determined. On the example of the typical figure 164-96-104 the results of calculations of the absolute values of subordinate measurable traits for women of all age groups in comparison with the total age group and data of the previous dimensional typology are given.

Keywords: anthropometric measurements, statistical

1. Introduction

This work was supported by the Foundation Grant of Ministry of education and research of the Republic of Kazakhstan.

One of the necessary conditions for the high quality of apparel garment products is its appropriate size and shape of the majority of consumers.

The fundamental basis of designing of mass production clothes, appropriate the requirements of quality planting, is the dimensional typology of the population. Obtaining evidence-based information about the dimensional characteristics of the body of consumers is becoming increasingly important for the production. Development dimensional typology is based on the data of mass anthropometric measurements of the population.

In Kazakhstan, designing clothing in mass industrial production is carried out in accordance with the specifications and technical documentation developed during the stay of the "Union", 1981-1986 years (Dunayevskaya et al., 2007), (OST, 1986), (OST, 1981), (Koblyakova et al., 1992), (Koblyakova et al., 2007), (Kurshakova 1978) (Kurshakova et al., 1974). This documentation specifies the number of typical figures, the necessary and sufficient for the industrial production, the classification of types of figures on portly and age group, the values of subordinate measurable traits of typical figures. Manufacture of women's clothing is recommended on 137 types, male - on 172 types.

However, over the past 30 years due to changes in the socio-economic structure of the country, population migration, generational change the typological structure of the population of Kazakhstan has changed. Several authors have noted the influence of acceleration processes: an increase in growth, the length of the arms and legs to the trunk, change the level of the waist line, posture and body indicators (Lopandina 2008), (Baskimbaeva, 2008), (Baskimbayeva et al., 2014), (Kyong Hwa Yi, 2011), (Hakimova, 2004).

OAO "Central Research Institute of the garment industry" (CRIGI) on the basis of the new anthropometric study of the population of the Russian Federation, conducted in 2002-2003., developed and implemented in the production of national standards (FS R 52771, 2007), (FS R 52773 2007).

In Kazakhstan today there are no documents regulating the requirements of modern dimensional typology of the

Republic of Kazakhstan, adequately reflects the dimensional characteristics of different population groups, including the figures of women, men and children. Dimensional characteristics of the body of consumers in RK currently applied to the industrial production of clothes is by the defined industry standard developed by the Central Research Institute of the garment industry of the Russian Federation in 1981-1986 (OST 17-325-86, 1986), (OST 17-326-81, 1981).

The use of the previous size typology leads to a mismatch of product designs to the structure of contemporary figures of consumers that has a significant impact on the competitiveness on the quality of the fit of the producing garments.

Designing clothes that meet the requirements of modern production and consumption market, should take into account the peculiarities of body shapes and proportions of Kazakhstan citizens as consumers of garments.

In view of the above there is a need to make studies on the development of the size typology for the population of the RK, which is the fundamental basis for the industrial production of the garments.

2. Methods

One of the main tasks of dimensional typology is finding the right balance of the sizes of the individual parts of the figure. Anthropological size types are characterized by a series of dimensional attributes. The best average values of measurements are determined depending on the set values of the leading dimension attributes on the multiple regression equation (Kurshakova 1978) (Kurshakova, 1974). As the leading features defining the type of a female figure, in clothing manufacture are chosen: body length (Height), third chest girth (Chest girth) and hip girth with the protrusion of the abdomen (Hip girth).

When designing clothes chest girth, length and hip girth with the protrusion of the abdomen are the main features that require compliance of finished products to the form of a human figure. In accordance with the height the product length is determined. The first one determines the size of clothes, the second - the length of the product, and the third - characterizes the type of female figure in plumpness.

Dimensional typology for the garment industry is based on the principle of uniformity of the increase of the subordinate dimensional signs, using the regression equation of the first degree type:

$$X_i = a + bX_1 + cX_{16} + dX_{19}$$

where X_i – any subordinate dimensional signs;

X_1 – Height

X_{16} – Chest girth

X_{19} – Hip girth.

Calculated the parameters of the central (most common) figure with the average values of the leading features, parameters related typical figures are determined by adding or subtracting the value of the increment.

The values of the leading and subordinate measurements are based on the mass anthropometric measurements of the female population of the Republic of Kazakhstan (Baskimbayeva et al., 2014). The sample size was 1,500. The obtained measurements were classified into four age groups in accordance with the data of the last census of the country (The age structure of the population ..., 2009). The program of the measurements consisted of 64 measurements of dimensional characteristics, of which in this paper for the purpose of designing clothes of the shoulder and waist range were selected 27 features. List of leading and subordinate features and method of removing the measurements are shown in Table 1.

Table 1. Method for measuring leading and subordinate dimensional characteristics

Number of the measurements	Name of measurements	Measurement method
1	2	3
		Leading measurements
1	Vertex height - Height	Distance from the floor to the vertex
16	Chest girth 3d	The tape passes horizontally around the body through the exposed points of the breast for women and closes on the right side of the

		chest.
19	hip girth with the protrusion of the abdomen	The tape is applied to the gluteal points. The tape extends horizontally around the body, in the front - along a flexible plate attached to the abdomen vertically to accommodate the protrusion of the abdomen, and closes on the right side of the torso.
		Subordinate measurements
7	Waist height	Distance from the floor to the waistline point on the side
9	Knee height	Distance from the floor to the knee point
13	Neck girth	The bottom edge of the tape is applied directly over the neck base point at the back. On the side and on the front the tape runs along the base of the neck, touching the clavicular point with the lower edge. The tape closes above the jugular notch (suprasternale point).
14	Chest girth, first	The tape is applied on the scapuli, on the back the tape goes horizontally, touching the rear angles of the axilla with the upper edge. On the front the tape passes over the base of the breast for women. Along the upper edge of the tape there are marks - for women over the exposed point of the breast, at the back – on the spine and shoulder blades.
15	Chest girth, second	The tape is applied on the scapuli, on the back the tape goes horizontally, touching the rear angles of the axilla with the upper edge, then along the axilla in the oblique section plane. The tape passes on the front around the body through the exposed points of the breast for women and closes on the right side of the chest.
17	Chest girth, forth	The tape passes horizontally around the body directly under the base of the breast and closes on the right side of the chest.
18	Waist girth	The tape passes horizontally around the body at the waistline level.
20	Hip girth	The tape is applied to the gluteal points. The tape extends horizontally around the body and closes on the right side of the torso.
21	Hip girth	The tape extends horizontally around the thigh touching the under gluteal fold with the upper fold and closes at the outside surface of the thigh.
22	Knee girth	The tape extends horizontally around the leg at the knee point level and closes at the outside surface of the leg.
23	Calf girth	The maximum girth of the calf muscle is measured. The tape extends horizontally around the leg and closes on the outside surface of the tibia.
25	Distance from the waistline to the floor aside	Distance from the waistline height point along the outside leg surface through the most protruding hip area and then to the floor
27	Inside leg length	Along the inside surface of the leg from the crotch to the floor with slightly spreaded legs
28	Upper-arm girth	The measurement is made perpendicular to the axis of the shoulder. The upper edge of the tape touches the rear angle of the axilla. The tape closes on the outside surface of the hand.
29	Wrist girth	The measurement is made perpendicular to the axis of the forearm along the wrist joint, through the head of the ulna. The tape closes on the outside surface of the hand.
31	Shoulder width	The measurement is made from the neck base point along the shoulder midline to the shoulder axis.
33	Distance from the neck base point aside to the wrist girth line	The measurement is made from the neck base point aside in the middle of the shoulder through the shoulder and radial points to the wrist girth line.
36a	Distance from the neck base point on the side to the waistline on the front	The tape extends on the front from the waistline through the bust point to the neck base point.
39	Distance from the neck base point back to the first and	The measurement is made from the neck point to the upper edge of the flexible plate. The plate touches the marks with the upper edge,

	second chest girth with the projection of the scapuli.	fixing on the blades the line of the chest girth and bust girth (see the measurement 14).
40	Back length to the waist with the projection of the scapuli	The measurement is made from the waistline to the neck base point on back along the spine through the thin plate with a width of up to 2 cm applied on the exposed points of scapuli.
44	The arc of the upper part of the trunk through the point of the neck base aside	The tape extends parallel to the spine from the waistline to the neck base point aside touching this point. On the front the tape extends from the exposed point of the breast, then down to the waistline.
46	Distance between the bust point	The measurement is made between the exposed breast points. The tape lies horizontally.
47	Back width	The measurement is made along the blades between the rear angles of the axilla directly over the first chest girth and bust girth. The tape lies horizontally.
48	Head girth	The measurement is made through the most protruding point of the nuchal crest and centers of any crests. The tape closes on the front.

- Numbering, naming and method of measurement of dimensional signs corresponds the currently used in the garment industry of Kazakhstan method described in (OST 17-325-86, 1986), (OST 17-326-81, 1981).

3. Results

The data obtained from anthropometric measurements were subjected to statistical processing.

The measurements of size 27 dimensional attributes of the female population of the Republic of Kazakhstan are classified into four age groups: younger 18-29, 30-39 and 40-49 middle age, the older 50-59.

Approaching the interpretation of the age changes it is necessary to take into account the age dynamics of the measurements. Conclusions about trends in the parameters of female figures were the result of comparing the results of the statistical parameters in the four studied age groups.

Table 1 shows the basic statistical parameters (arithmetic mean figure X_j and standard deviation S_j) leading and subordinates measurable traits of the female population of the Republic of Kazakhstan

Table 1. Basic statistical parameters of dimensional attributes of the female population of different age groups

NO	18-29 years old		30-39 years old		40-49 years old		50-59 years old	
	X_j , cm.	S_j , cm.						
1	166,89	5,2	165,44	5,04	160,27	5,26	157,58	5,9
16	89,29	7,04	95,72	9,29	99,37	10,4	99,94	10,4
19	97,6	7,54	102,7	10,3	106,6	10,9	108,3	8,45
7	102,66	5,41	101,68	5,11	98,98	5,43	96,76	5,9
9	46,21	2,9	44,35	2,75	44,44	3,11	43,47	3,4
13	32,77	3,47	34,07	3,22	34,73	3,13	34,70	2,9
14	86,37	6,79	92,55	8,52	96,67	10,26	95,23	8,8
15	92,12	7,57	98,33	10,08	102,38	10,99	102,03	10,53
17	71,96	7,02	81,02	10,66	83,95	9,83	87,58	11,5
18	72,31	9,37	80,23	12,85	85,00	12,13	86,95	13,3
20	95,48	4,99	99,64	7,92	102,45	10,62	104,6	11,9
21	50,10	5,21	53,85	6,67	55,79	7,32	54,76	5,5
22	36,32	3,53	37,86	3,82	38,58	4,2	38,95	4,0
23	33,39	2,99	34,08	3,76	34,64	4,5	34,75	3,5
25	105,59	5,29	104,94	5,08	99,01	4,94	95,85	5,6
27	75,95	4,86	74,34	5,07	69,0	4,3	68,80	5,3
28	27,06	3,37	30,69	3,65	31,50	3,43	31,56	3,7
29	16,08	1,07	16,66	1,29	16,63	1,36	16,71	1,6
31	12,32	0,73	12,40	0,83	12,66	0,74	12,91	0,8
33	67,23	3,17	67,74	3,39	67,66	3,0	67,46	2,9
36a	40,74	0,66	41,51	2,97	42,04	3,2	42,96	3,2

39	20,31	1,66	20,29	1,57	20,44	1,28	20,30	1,5
40	37,05	2,06	37,99	2,42	38,06	2,45	38,60	2,7
44	78,57	4,27	82,23	5,25	83,46	5,72	84,1	6,5
46	17,93	1,63	19,55	1,82	19,91	1,95	20,42	2,1
47	35,94	3,48	37,15	3,2	37,80	2,75	37,43	2,5
48	55,43	1,54	55,91	1,47	56,09	1,43	55,89	1,7

As it is seen from the data in Table 2, the central type of female figure in the age groups 40-49 and 50-59 is a figure with the values of leading dimensional attributes 158 - 100 - 108. In the age group 18-29 years - the central figure type 170-88-96, and in the group of 30-39 years - 164-96-104.

With the age, the high-altitude measurements (body length, the height of the waist, inside leg length) reduce. The character of the changes is shown in Figure 1.

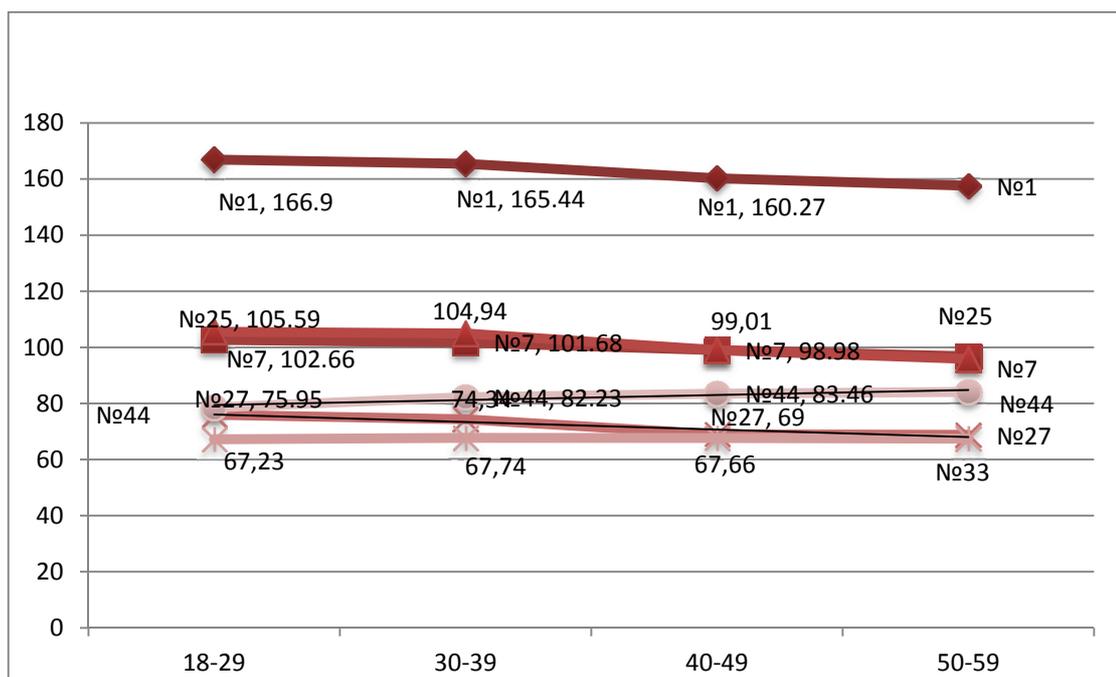


Figure 1. The dynamics of characteristics variability, depending on the age factor

As it is seen in Figure 1, with the age the majority of high-rise size signs reduce, except the measurement #33 - «Distance from the neck base point to the wrist girth line», #48 - «Head girth." Increasing the length of the upper part of body (#44) and a corresponding decrease in the length of the lower extremities (the dimension attributes number 25 and 27) indicate that with the age there is a tendency to brachymorphic type of proportions (more elongated torso and shorter lower extremities).

Using data from table 2 regression equations were calculated on the basis of which, depending on the values of the leading dimensional characteristics the values of subordinate dimensional characteristics were calculated. In table 3 on the example of the typical figure 164-96-104 the results of calculations of the absolute values of subordinate measurable traits for women of all age groups in comparison with the total age group and data of the previous dimensional typology are given.

Figure 2 graphically shows the change in girth measurements, depending on age.

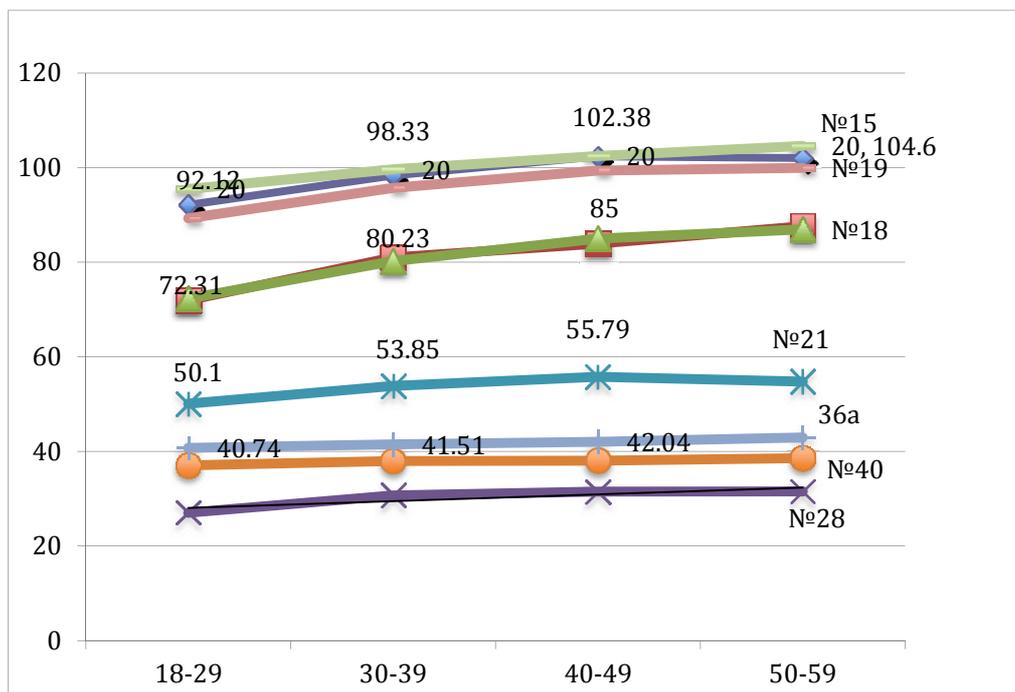


Figure 2. The dynamics of girth measurements change, depending on the age factor

As it is seen in Figure 2, with age girth dimensional signs are increasing. The largest increase is observed on the dimensional signs: waist girth (#18), hip girth with the protrusion of the abdomen (#19), hip girth, excluding the protrusion of the abdomen (#20), chest girth second(#15). Some smaller with age shoulder girth (#28) and hip girth (#21) vary.

Table 3. The values of the subordinate measurements for women in the all age groups, for woman figure type 164-96-104

Number of the dimensional sign	18-29 years old	30-39 years old	40-49 years old	50-59 years old	Total age group	By [3]	Difference, cm
7	100,1	100,3	99,5	91,3	97,8	103,2	-5,4
9	45,0	42,3	46,4	46,6	45,1	45,4	-0,4
13	34,6	35,0	38,72	35,0	35,8	37,0	-1,2
14	91,3	93,4	93,0	91,3	92,3	91,8	+0,5
15	99,5	99,6	100,1	95,7	98,7	101,0	-2,3
17	78,7	86,1	82,0	84,7	82,9	83,0	-0,1
18	80,26	82,2	82,1	87,3	83,0	75,8	+7,1
20	99,8	100,5	100,0	99,4	99,9	101,0	-1,1
21	60,4	56,9	55,5	54,6	56,8	58,4	-1,6
22	37,4	39,0	39,0	38,6	38,5	37,2	+1,3
23	34,9	35,3	35,1	35,2	35,1	36,1	-1,0
25	104,2	103,8	102,0	101,2	102,8	106,1	-3,3
27	72,8	72,7	66,8	67,0	69,8	76,5	-6,7
28	30,0	32,3	30,5	29,5	30,6	30,4	+0,2
29	16,8	16,9	16,7	16,8	16,8	16,5	+0,3
31	12,7	12,7	12,8	13,3	12,9	13,4	-0,5
33	66,9	64,5	66,9	69,4	66,9	68,9	-2,0
36a	40,7	42,9	42,9	44,2	42,7	43,9	-1,2
39	20,4	20,3	20,8	20,8	20,6	17,9	+2,7

40	36,9	38,5	38,5	40,0	38,5	40,3	-1,8
44	81,41	81,9	84,4	85,2	83,1	87,2	-4,1
46	19,0	19,7	19,7	20,0	19,6	20,1	-0,5
47	38,2	38,0	37,6	37,3	37,8	36,5	+1,3
48	55,56	55,8	56,23	56,2	55,9	55,6	+0,3

As it is seen from the data in Table 3, the values of dimensional attributes for the same type of female figure growth of 164 cm, chest girth of 96 cm. and a girth of hips with the protrusion of abdomen 104 cm are different.

Methods for measuring a number of dimensional attributes in the same dimensional typology substantially differ from the conventional methods in European standards (Kyong Hwa Yi., 2011), (EN 13402-1, 2001), (EN 13402-2, 2001), (EN 13402-3, 2004), (EN 13402-4, 2004).

For example, a method for measuring length of the arm, characterized dimensional feature #33 - The distance from the base of the neck aside to the line of girth of the wrist, differ in that by the procedure (OST 17-325-86, 1986), (OST 17-326-81 1981), this dimension is removed from the base of the neck point aside and not from the point of the back of the neck (the seventh cervical vertebra), as it is adopted in (EN 13402-1, 2001), (EN 13402-2, 2001), (EN 13402- 3, 2004), (EN 13402-4, 2004).

According to the currently used methods of conducting anthropometric surveys (OST 17-325-86, 1986), (OST 17-326-81, 1981), there are two measurements of the girth at the hips, taking into account the protrusion of the abdomen (#19, is the leading dimension sign for female figures) and without protrusion abdomen (#20, subordinate symptom, calculated on the basis of leading sign #19). In the existing methods (OST 17-325-86, 1986), (OST 17-326-81, 1981) there are the dimensional signs #14 - girth of chest first and #44 - Arc of the upper body through the point at the side of the neck, that are missing from the European measurement standards (EN 13402-1, 2001), (EN 13402-2, 2001), (EN 13402-3, 2004), (EN 13402-4, 2004). Methods for measurements of dimensional attributes in the existing technique (OST 17-325-86, 1986), (OST 17-326-81, 1981) are adapted to the currently used methods in Kazakhstan structural design of clothing (Baskimbaeva, 2008), (Martynova and Andreeva, 1999) (CBSTI 1982) (CSIIIGP 1988).

Depending on the age a number of significant dimensional attributes for the design of clothing change. As it is seen from the analysis of the variability of high-altitude measurements with the age the value of dimensional attributes decreases: #1 - growth, #7 - Height waistline, #25 - Distance from the waist to the floor aside, #27 - Foot length on the inner surface and #33 - The distance from the base of the neck to the point of the line of wrist girth. Girth measurement (#15 - chest girth, #18 - waist and #21 - hip) in women significantly increased with the age. Slightly increased depending on the age the shoulder girth (#28).

A significant change in dependence of the age factor, and compared with the data of the same dimension typology is observed for the attributes "distance from the waist to the floor aside" and "leg length along the inner surface."

The results of calculations of the absolute values of subordinate measurements for women of all age groups of the same types of figures (164-96-104) in comparison with the total age group and data of previous dimensional typology indicate of available changes of the numerical values of subordinate characteristics. For example, waist girth for the first age group of women for a typical figure 164-96-104 is 80.3 cm, for women over 50 years old - already 87.3 cm that is 7 cm more. On average, women of total age group of the size 164-96-104 waist girth are 83 cm. A comparison of the numerical values of the dimension of feature waist girth with the same dimensional typology data also shows a significant difference (7.1 cm.). With regard to the structural design of apparel products waist, width pants and skirts in the design of the same size-growth - is different: in the products of the younger age group - 80 cm, the eldest - 87 cm.

Level waistline garments, characterized by a dimensional sign #7 (waist height) for women younger and middle age groups (18-29, 30-39 and 40-49) will be located above an average of 8-9 cm, compared with the products of the older age group of 50-59 years. Consequently, the length of women's trousers of the same height (in our example, the growth is 164) will be for the younger age group more on 8-9 cm., than similar products for older age group. If we analyze the change in dimensional sign #44 - the length of the upper body part, respectively to figures of the younger and older age groups, the length of the bodice in the products of one-size growth is the different by 3-4 cm.

Analysis of the signs of figures posture characterized by the difference of measurements "front waist length» (#36) and "back waist length» (#40) shows that the female figures of younger age group have more straightened

posture, older - more stooping. As a consequence, the value of the balance of the construction of sewing shoulder garments in clothes of the younger age group is less, senior - more.

The length of the hands, characterized by dimensional signs #33 - the distance from the base of the neck to the wrist girth line, based on the results of these studies has decreased by an average of 2 cm compared with the data of the previous dimensional typology. However, subject to dimensional sign #31 - shoulder width (as the term of sign #33), a decrease in the length of the arms will be 1.5 cm.

4. Conclusions

On the basis of statistical processing of the measurement data of the female population of the Republic of Kazakhstan significant difference of the numerical values of dimensional attributes, depending on age is revealed.

The first age group of 18-29 years, the central type of female figure is the figure with the following parameters: 170-88-96. In the second and third age groups - 164-96-104. In the older age group the central type - 158-100-108.

Based on the correlative-regression analysis, the absolute value of a number of important structural design of clothing, subordinates dimensional attributes depending on the leading was determined. Comparison with the previous dimensional typology showed significant differences of several signs. According to the data, typical to the women of the Republic of Kazakhstan of the total age group waistline is more at 7 cm, compared to similar data from the previous dimensional typology. The length of the leg on the inner surface (#27) is less by 6.7 cm, and the distance from the waistline to the floor aside (#25) is less by 3.3 cm.

In general, for the same type of female figure (e.g., 164-96-104) the numerical values of most of dimensional characteristics have substantial differences in certain, and in total age group.

Received data about the values of dimensional attributes peculiar to the age groups of women should be used in the design and construction of the shoulder and belt assortment of clothing.

The calculated numerical values of subordinate dimensional attributes for four age groups are recommended for structural design clothes on female figures of the Republic of Kazakhstan.

Application of the obtained results in the practice of designing women's apparel assortment will ensure proportionality and balance of production to figures of consumers of different age groups.

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