Some Anthropometric Reference Values of Elderly Individuals for Medical Apparatus Application in City of Sivas, Turkey

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Abstract

This study aims at understanding of importance the design appropriate medical apparatus with anthropometric measure methods for the elderly against the all kinds of accidents, injuries and fractures. 50-64 and age 65+ years men and women, who live in Sivas, -total of 295 persons- was separately evaluated and some anthropometric measurements were taken according to protocol recommended by Anthropometric Standardization Reference Manual and International Biological Programme. The obtained data were transferred to a computer from work sheets and SPSS 14.00 was used to analyse the demographic and anthropometric data of individuals. According to the findings obtained from this study is that average, min-max and standard deviation values of taken anthropometric measurements were determined and after 65 years of changes in both sexes are evaluated. The significance of these data is to determine the health status of individuals who are older and older and to design appropriate medical apparatus for elderly.

Key words: Medical Apparatus, Anthropometric Measurements, Elderly

Introduction

Presence of genetic variation is a fact in human population like any other organism. An individual has a specific physical structure and capacity because of his/her unique genetic makeup and environment. Each human population also has a special gene pool and consequently specific anthropometric values resulting from their independent evolutionary and demographic history (Akın, 2006). Anthropometry is the size of the human body and dimensions of other physical properties (Hedge, 2013). The use of anthropometry is very important in particular, in determining the nutritional and health status of individuals as well as in the assessment of growth (Fawkner, 2013), and it is also important determinant of clinical change (Kliska, 2012). In the analysis of anthropometric values of the individual, the person's health status, genetic structure, socio-demographic structure, diet and lifestyle are some of the decisive criteria (Gavriilidou et al., 2015). Anthropometric evaluation may be utilised as important indicators for determination of nutrition and health state of a human society (Sánchez-García et al., 2007). Nevertheless, malnutrition, obesity, muscle loss and increases of fat mass are one of the indicators of the results obtained from the evaluation anthropometric measurements (Sanchez-Garcia et al., 2007).

Each individual has different body size. The examined individuals is important to show the rate of change within the group, when specifying the anthropometric data. Therefore, anthropometric data is considered with the statistical figures as percentile (Tiley, 1993; Oberne, 1995; Yazıcıoğlu ve Erdoğan, 2007). To be used percentile values, to be held in ergonomic design, the design is very important in terms of reflecting the community fully. For this reason, the expected performance from researchers is that Anthropometric data are considered in accordance with the physical size and shape of the individual to be designed more ergonomically comfortable way (Parkinson and Garneau, 2016).

Aging is an inevitable process that started in middle age of individual and until the death of the individual as chronological period. With the aging process, it begins to emerge changes in the physical and nutritional structure of individual. It weakens the muscle-skeletal structure of the individual with the loss of weight and height and appears to decreased their muscle density; however, their fat mass is increased (Sanchez-Garcia et al., 2007). The deceleration in physical function of individuals is more pronounced with aging (Leite et al., 2014).

As a result of this system disorder begin to appear formal and functional changes in body composition. The ageing process involves considerable decline in physical and mental capacities of the population resulting in chronic health problems. A variety of chronic conditions associate with aging may lead to various accidents and serious injuries. In order to avoid such ageing related accidents and injuries, living environment of elderly requires a special attention. Designations of living environment as well as tools used in daily life or for medical proposes require information on anthropometric measurements of population concerned (Atamtürk, 2010).

The main aims of present study were (1) to survey anthropometric measurements of middle age and elderly population of metropolitan Sivas province; (2) to describe differences between two age group as well as between genders; (3) to help to designers to design specifically suited products, equipment, and living facilities for the elderly population for lack of proper data.

1. Materıal and Method

The present study was approved by the Ethic Committee of Cumhuriyet University and each subject was properly informed before the application. The anthropometric measurements were taken at subjects' homes by a trained person. Subject was encouraged to wear lightweight clothing with barefoot during the measurement process and measurements were taken from left side to avoid possible deformation caused by over usage (Akın, 2001).

A cross sectional survey was conducted to collect anthropometric data in two age groups in a random and voluntary sample of 295 persons consisting of 152 females and 143 males in metropolitan Sivas province, Turkey. The middle age group (between 50 and 64 years old) included 95 women and 96 men whereas the old age group (65 and over) included 57 women and 47 men. A total of 17 anthropometric measurements including weight, length, underside length, lower leg (tibia) length, foot length, foot wideness, tibia length, elbow wideness, knee wideness, wrist circumference, neck circumference, waist circumference, abdomen circumference, pelvis circumference, calf of the leg (tibia) circumference, femur circumference and ankle circumference were taken.

The measurements were taken according to protocol recommended by Anthropometric Standardization Reference Manual (ASRM) and International Biological Programme (IBM). The data collected for each individual were transferred to a computer from work sheets and SPSS 14.00 was used to analyse the anthropometric and demographic data of individuals (Weiner and Lourie 1969, Tanner et al. 1969). Because the standard deviation of the study sample was not known the student's t test was conducted to test the statistical significance of differences between two independent groups (Özdamar, 1999). The anthropometric measurements were presented as mean value, standard deviation and percentiles (P5, P10, P25, P50, P75, P90 and P95) to display distribution of the individuals within the group (Tiley, 1993; Oborne, 1995; Yazıcıoğlu ve Erdoğan, 2007).

2. Findings

2.1. Percentile Values

It has been seen in weight, length, underside length, lower leg (tibia) length, foot length, foot wideness, tibia length, elbow wideness, knee wideness, wrist circumference, neck circumference, waist circumference, abdomen circumference, pelvis circumference, calf of the leg (tibia) circumference, femur circumference and ankle circumference belonging to measure reference percentile values on table 1, 2, 3, 4 and graphs 1, 2, 3 (50-64 years of age and 65+).

Table 1: 50-64 years of woman age percentile values

50-64 YEARS OF WOMAN AGE							
MEASUREMENT	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**
Length	1427,75	1456,4	1500	1536	1565,25	1592,1	1630,9
Weight	60,34	65,41	70,57	77,3	86,47	97,48	101,67
Underside Length	747,55	770	813,5	859,5	893	917	942,1
Lower leg Length	352	364	380	402	419	441,4	453,4
Foot Length	215,85	220,7	226	231,5	239,75	243,6	251,15
Foot Wideness	79,4	82,75	85	90	94,75	99,3	102
Tibia Length	296	305	320	337,5	353	375	381,23
Elbow Wideness	52	55	60	62	67	70,3	74
Knee Wideness	74,25	80,7	89	96	101	111	114
Wrist Circumference	150,85	160	164,25	172,5	181	190	193,05
Neck Circumference	323,55	331,7	351	363	381	396,3	406
Waist Circumference	805,7	894,7	932,5	993	1078,75	1148,3	1198,8
Abdomen Circumference	986,9	1015,7	1070,25	1146	1227	1312,5	1365,8
Pelvis Circumference	1023,7	1054	1099,25	1179	1245	1345,5	1388,7
Calf of the Leg (Tibia) Circumference	327,3	344,2	365	383	414	452,6	476,6
Femur Circumference	402,25	424,5	466,75	499,5	540,5	586,8	610,15
Ankle Circumference	215,85	219,7	231,25	250,5	270,75	286,3	305,15

Table 2: 65+ woman percentile values

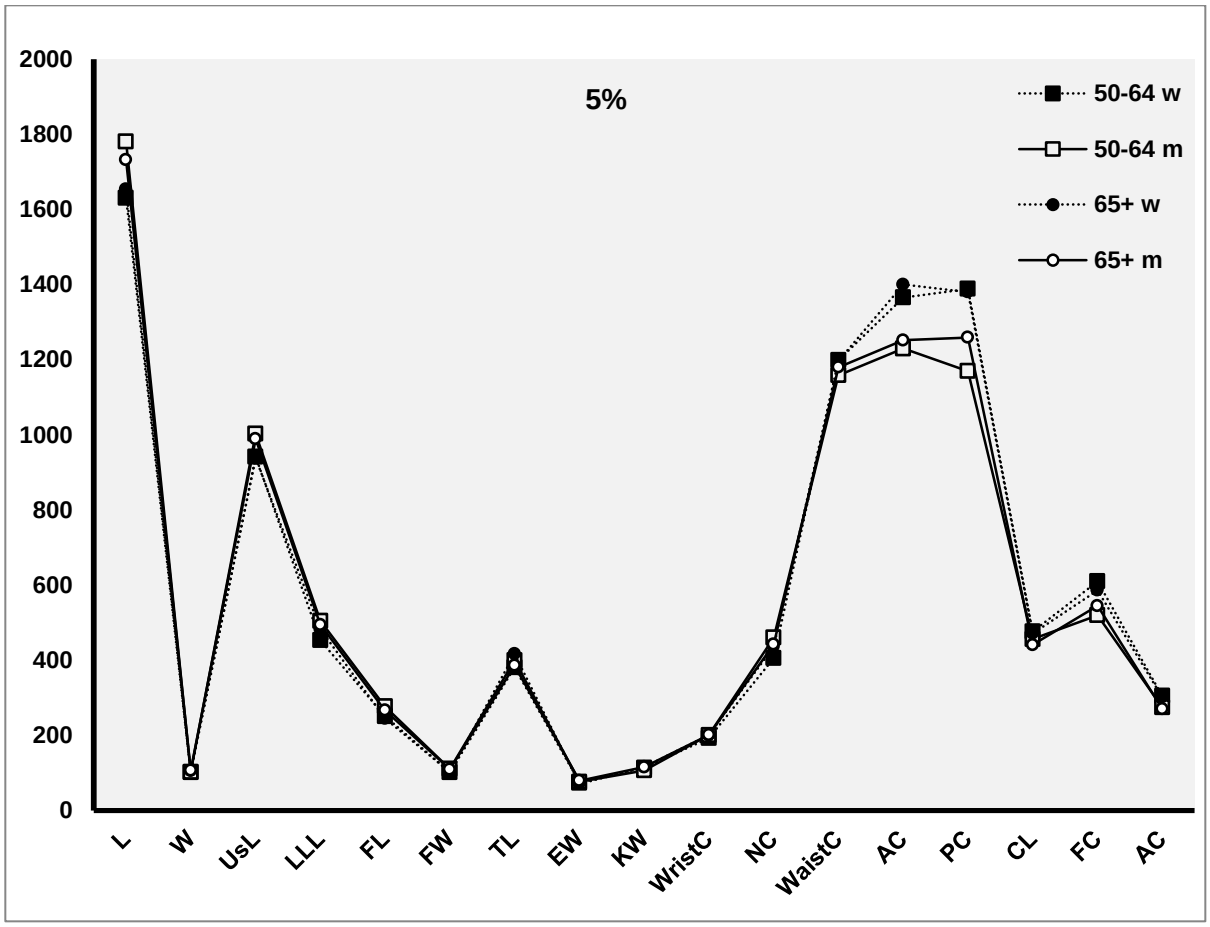
	65 + WOMAN						
MEASUREMENT	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**
Length	1429,65	1435,5	1469,5	1506,5	1555	1615,5	1653,65
Weight	52,34	61,17	69,9	75,8	87,6	96,15	105,93
Underside Length	729,05	753,5	798,75	827,5	875,75	906,1	937,7
Lower leg Length	346,85	359,2	381	392	418,75	435,1	483,05
Foot Length	206,95	211,9	221	229	235	243	245,2
Foot Wideness	80	81,9	86	89,5	94,25	99,1	102,05
Tibia Length	275	297,5	315	336,5	350,75	368,3	416,7
Elbow Wideness	51,9	54	59,75	61	65,25	70	71,15
Knee Wideness	65,9	73,6	85,75	96,5	105,25	110,1	116,2
Wrist Circumference	154,75	159,9	165	175,5	182	191,1	201
Neck Circumference	301,95	330,9	351	366,5	382	402,2	436,25
Waist Circumference	841,1	868,1	999	1050	1101,75	1159,9	1196,8
Abdomen Circumference	988,7	1029,5	1112,5	1200	1263	1293,3	1400,25
Pelvis Circumference	1002,95	1030,9	1095,25	1170,5	1281,75	1328,3	1380
Calf of the Leg (Tibia) Circumference	299,6	314,5	346	376	407,25	436,3	471,45
Femur Circumference	355,8	378,9	423,25	480	518	560,9	586,25
Ankle Circumference	194,9	211,4	226	248	267	290,9	301,95

Table 3: 50-64 years of man age percentile values

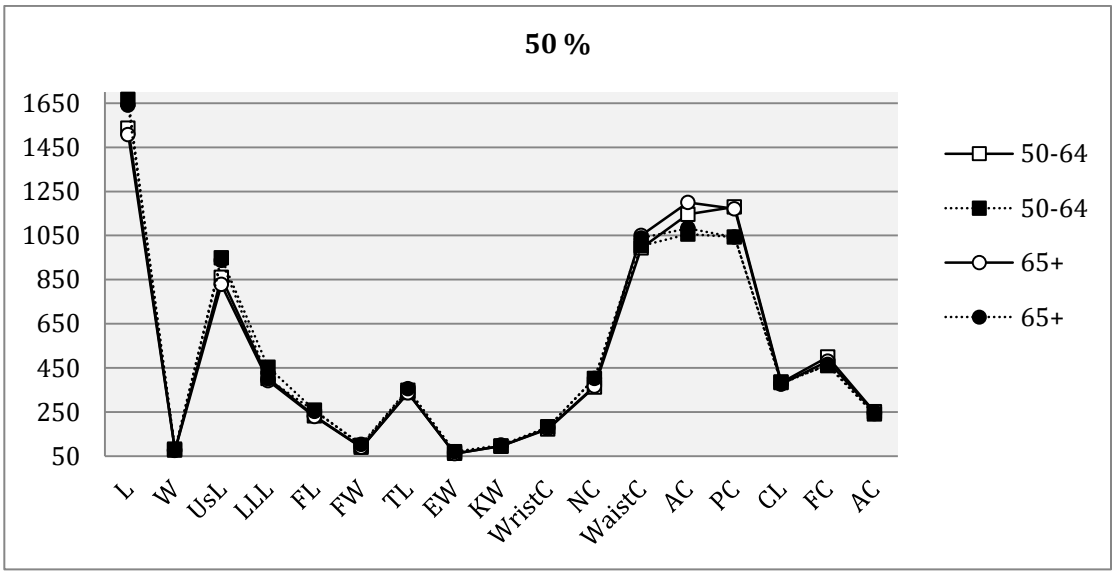
50-64 YEARS OF MAN AGE							
MEASUREMENT	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**
Length	1561,25	1592,5	1631	1666,5	1720	1768	1781
Weight	56,8	64,25	73,55	80,85	87,4	97,1	103,17
Underside Length	860	893,4	920,5	949	982	998,6	1003
Lower leg Length	404,9	411,4	425	453	479	498	505,2
Foot Length	234	240,5	248,75	257,5	264,25	273,5	277,25
Foot Wideness	88,75	91	95	99	103	108	111
Tibia Length	308,5	318,8	331,5	348	370	387,2	399,8
Elbow Wideness	59,75	60,5	63,75	69	71	73	76,75
Knee Wideness	75	80,5	87	94,5	100	105	106,75
Wrist Circumference	164,5	170,5	174	182,5	192	197	201
Neck Circumference	352	370	387,75	402	422,25	450,5	460,25
Waist Circumference	824,25	871,5	952	1003,5	1042,5	1124,5	1158,5
Abdomen Circumference	856	892,5	999,5	1056	1098	1197,5	1229,75
Pelvis Circumference	889	938	996	1043	1100,25	1150,5	1169,75
Calf of the Leg (Tibia) Circumference	329,25	341,5	360,75	386	406	425	456,5
Femur Circumference	368,75	379	425,5	460	492,25	517	519,75
Ankle Circumference	213,5	219,5	230	240	254,25	262,5	275,25

Table 4: 65 + man percentile values

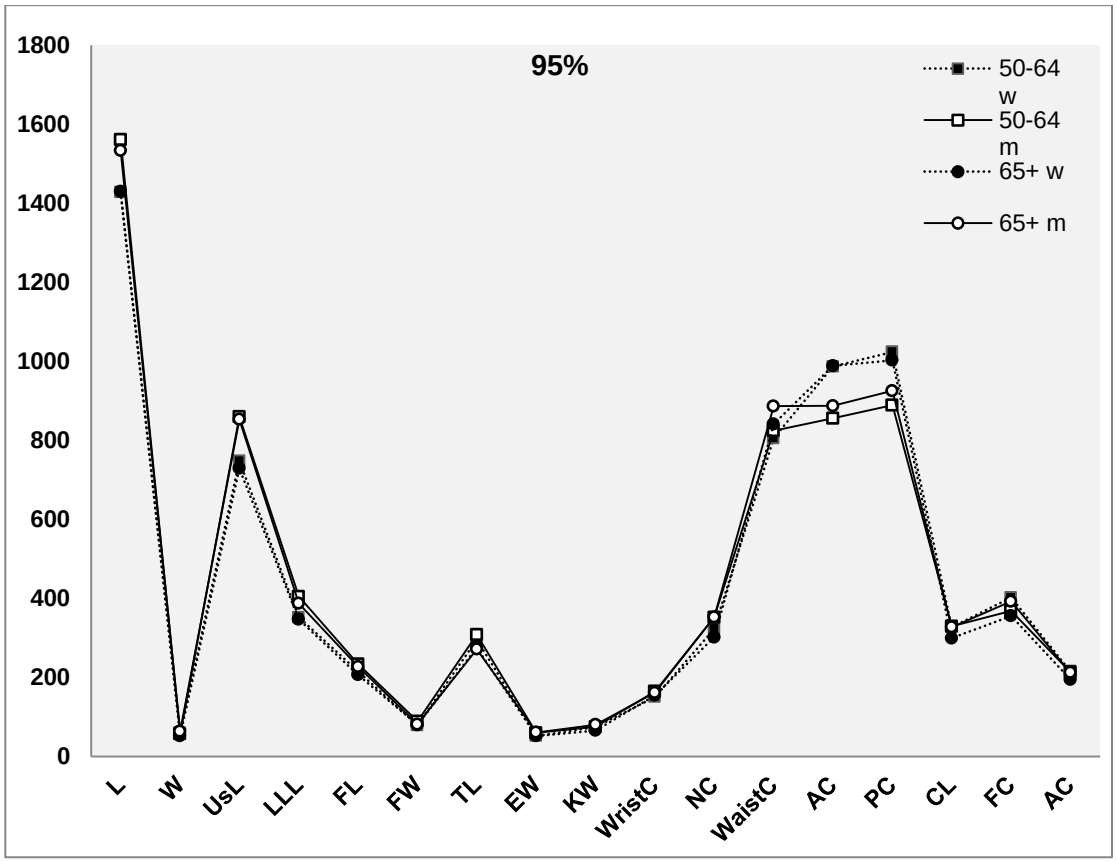
	65 + MAN						
MEASUREMET	**P5**	**P10**	**P25**	**P50**	**P75**	**P90**	**P95**
Length	1533,8	1557,4	1601	1640	1680	1719,6	1732,4
Weight	63,84	65,32	69,9	76,8	86,8	95	106,74
Underside Length	852,8	860,6	893	937	963	977,2	989,2
Lower leg Length	387,2	403,4	426	450	470	486,2	494,6
Foot Length	227,4	235,0	245	252,5	259,25	263	266,95
Foot Wideness	81,7	90,0	99	103	106	107,3	110
Tibia Length	271,6	313,0	330	355	370	381	386
Elbow Wideness	61,0	63,6	68	70	74	76	79,6
Knee Wideness	80,4	89,2	94	100	104	113,4	115,6
Wrist Circumference	162,0	170,8	175	182	192	100,2	201,6
Neck Circumference	353,0	362,6	391	402	421	438	442,6
Waist Circumference	886,4	907,2	955	1039	1110	1144,4	1179,8
Abdomen Circumference	887,4	943,6	1000	1083	1141	1218,2	1252
Pelvis Circumference	925,4	958,4	1008	1042	1107	1206	1259
Calf of the Leg (Tibia) Circumference	327,6	335,2	355	379	395	423,8	441,2
Femur Circumference	392,6	396,8	424	465	496	524	545,2
Ankle Circumference	212,4	220,0	229	242	256	265,8	270,8



Graph 1: 5% percentile values of anthropometric measurements of individuals in the sample



Graph 2: 50% percentile values of anthropometric measurements of individuals in the sample



Graph 3: 95% percentile values of anthropometric measurements of individuals in the sample

(**L**: Length; **W**: Weight; **UsL**: Underside Length; **LLL**: Lower leg Length; **FL**: Foot Length; **FW**: Foot Wideness; **TL**: Tibia Length; **EW**: Elbow Wideness; **KW**: Knee Wideness; **WristC**: Wrist Circumference; **NC**: Neck Circumference; **WaistC**: Waist Circumference; **AC**: Abdomen Circumference; **PC**: Pelvis Circumference; **CL**: Calf of the Leg (Tibia) Circumference; **FC**: Femur Circumference; **AC**: Ankle Circumference)

2.2. Anthropometric Values

In tables 5 and 6, it is given minimum, maximum, mean, standard deviation and p values of the anthropometric measurements (weight, length, underside length, lower leg (tibia) length, foot length, foot wideness, tibia length, elbow wideness, knee wideness, wrist circumference, neck circumference, waist circumference, abdomen circumference, pelvis circumference, calf of the leg (tibia) circumference, femur circumference and ankle circumference).

Table 5: Anthropometric measurement values of 50-64 years age of women and men

Measurement	Woman (n=95)				Man (n=96)				
	min.	max.	mean.	sd	min.	max.	ort.	sd	p value
Length (mm)	1290	1715	1530	60,42	1490	1790	1672,61	63,75	0,001*
Weight (kg)	51,1	114,8	79,25	12,46	54,9	136,4	80,75	13,44	0,426
Underside Length (mm)	705	978	851,06	56,77	365	1008	940,41	73,33	0,001*
Lower leg Length (mm)	270	499	400,33	32,87	360	518	452,97	32,47	0,001*
Foot Length (mm)	200	264	231,8	62,3	227	280	256,26	12,21	0,006*
Foot Wideness (mm)	51	104	89,64	8,06	81	112	101,33	6,9	0,001*
Tibia Length (mm)	224	830	340,85	57,9	265	750	354,59	49,78	0,084
Elbow Wideness (mm)	51	89	63,51	6,58	53,81	81,45	67,45	5,34	0,001*
Knee Wideness (mm)	60	133	94,75	14,02	60	131	96,7	12,96	0,136
Wrist Circumference (mm)	106	203	172,4	10,18	160	239	184,7	1,61	0,821
Neck Circumference (mm)	301	472	365,7	2,83	290	480	404,93	3,54	0,001*
Waist Circumference (mm)	571	1227	1002,6	11,14	872	1292	988,8	13,36	0,442
Abdomen Circumference (mm)	876	1528	1155,3	11,56	734	1406	1041,3	10,61	0,001*
Pelvis Circumference (mm)	95	1472	1189	10,87	425	1416	1052,6	11,38	0,001*
Calf of the Leg (Tibia) Circumference (mm)	259	581	391,2	4,83	258	572	386,1	4,23	0,436
Femur Circumference (mm)	376	686	504,6	6,08	366	586,5	453,1	6,7	0,001*
Ankle Circumference (mm)	209	314	252,9	2,67	200	376	242,5	2,21	0,004*

***p<0,05 significant**

Table 6: Anthropometric measurement values of 65+ years age of women and men

Measurement	Woman (n=57)				Man (n=47)				
	min.	max.	mean.	sd	min.	max.	mean.	sd	P value
Length (mm)	1362	1790	1514	71,37	1513	1753	1638,23	50,04	0,243
Weight (kg)	41,1	106,7	77,7	13,89	63,3	109,1	79,32	11,77	0,527
Underside Length (mm)	684	997	832,98	60,9	837	997	927,38	41,89	0,001*
Lower leg Length (mm)	292	528	397,76	36,98	368	502	445,64	30,49	0,001*
Foot Length (mm)	206	276	228,71	11,69	220	275	251,02	11,11	0,001*
Foot Wideness (mm)	79	109	90,14	6,4	85	113	100,81	15,53	0,001*
Tibia Length (mm)	267	827	343,29	71,57	243	392	346,8	30,91	0,754
Elbow Wideness (mm)	49	85	62,34	6,29	49	81	73,11	5,49	0,001*
Knee Wideness (mm)	63	131	94,69	14,41	92	119	99,17	10,58	0,078
Wrist Circumference (mm)	141	176	174,98	21,03	146	180	184,82	23,61	0,623
Neck Circumference (mm)	286	482	366,4	3,67	310	470	401,91	5,98	0,001*
Waist Circumference (mm)	794	1256	1037,3	10,24	862	1234	1037,4	8,9	0,006*
Abdomen Circumference (mm)	929	1549	1193,1	11,59	842	1272	1077,5	10,07	0,001*
Pelvis Circumference (mm)	876	1422	1177,2	11,65	919	1321	1061,9	8,99	0,001*
Calf of the Leg (Tibia) Circumference (mm)	271	494	377	4,7	296	456	375,4	3,22	0,847
Femur Circumference (mm)	342	62	473	6,79	374	559	462,2	4,46	0,353
Ankle Circumference (mm)	190	344	249,1	3,09	204	284	243	1,77	0,231

***p<0,05 significant**

3. Dıscussıon and Result

In rapidly developing world, it is experiencing a major demographic change. While the population is increasing gradually, on the other hand, the development technology and the increase of scientific studies are caused the improvement of health conditions. Therefore, mortality is reduced. In recent years, developed in industrialized countries shows a rapid increase in the elderly population. This situation is now limited to the western countries (Dubey et al, 2011).

The sample is consists of different gender individuals who age groups over 50 in the city of Sivas. In addition, the number of women in our individual is selected by stratified sampling method and the number of woman is greater than man. This situation is related to increase of women' longevity. It may also cause that men work more difficult and dangerous conditions by women, so their bodies physically undergoes more deformation. It supports our research. The prevalence of the industrial sectors in Sivas (especially railway and mining) increases the depreciation of males. This is a difficult situation for men, especially in their old age.

As a result of the statistical analysis, it should not look at the only average value; because mean values design are only comprises a part of the community. P5, P10, P25, P50, P75, P90 and P95 values should also be taken into consideration for the benefit of the entire community in designs. In this case, individuals can be used in a comfortable way to designs, and so, studies can be done to raise the quality of life of individuals aged 50 and above, particularly (Table 1, 2, 3, 4).

Height of the male was higher than women in both age groups in terms of age groups and genders in 5%, 50% and 95% percentile charts, when examined percentile charts. However, in the vicinity of the abdomen and pelvis; female individuals were found to be higher than in male subjects in both age groups (Figure 1, 2, 3).

According to obtained data, it has been seen to decline in average height after 65 years (then with age, height, regardless of the gender difference) (Table 5, 6). This situation is similar to other studies. For example, 60 years and older in anthropometric studies of the elderly living in Mexico (October 1996-July 1997) by Mexican Social Security Institute (IMSS), it has been seen the average value of the 870 women in height 152.6 cm; the average value of the 1098 men in height 163.2 cm (Sanchez- Garcia et al., 2007).

With advancing age, it is comprised the degeneration of the spine and disc of individuals in their body. In addition, it may be significantly shorter in length proportion because of forward bend in body posture, cartilage tissue between the vertebrae in resulting water loss and the changes of discs. This decrease in the average length has been seen after the age of 50 and each five years, there is a reduction 2,5 cm in length. Then, after 75 years, each five years, there has been a decline of 5 cm in length (Akin, 2012). The reason for the significant drop in the height loss in women is menopause. Bone structure in women begins to weaken together with menopause and occurred of mineral loss in bones, and so curvature of the spine begins with bone resorption. These factors affect the height development.

Another measure is the weight in determining the physical structure of the human. Weight also varies according to age and sex of the individuals. This research data as shown in Tables 5 and 6 is reduced weight loss after 65 years. This reduction is also valid for both sexes. In both sexes, it is found to be greater in body weight in this research. As caused by the reduction in the weight loss after 65 years age, reduction in body water content, decrease in bone density, decrease in muscle mass and physical inactivity may shown in many studies (Gültekin et al., 2005). We can say that the reasons for the weight loss in women are different than men. The most important factors are menopause and hormonal changes. The average age of menopause in women between the ages of 45-55. After this period, eating more food may be needed with change in the hormonal balance in women. Muscle and bone degeneration occur with menopause and decrease the body fat and so, weight loss begins (World Health Organization, 2003; Coroney, 1981).

It is shown a decrease in the average length of the foot in both men and women in 65 years old and older individuals (Table 5, 6). In the same way, it is considered as caused by other anthropometric measurements such as muscle and bone loss. Foot width of women in the age group 65 years and above have been seen an increase (Table 5, 6). This is because 65 years old and older individuals' feet are swollen due to diabetes, varicose veins and cardiovascular diseases. In particular, older individuals who have this disorder should go to health institutions for the cause of leg swelling.

Neck circumference means values are lower than in women (Table 5, 6). This may result from gender-specific differences. Women, who has 65 and older group, on average compared to the other age groups did not change; the neck circumference of men are seen in the decline in the 65+ age group. The reason for this decline can be the reduction of subcutaneous adipose tissue and weight loss.

Waist circumference average value of women is higher than men, when looking at the waist circumference. The reasons of having more weight of women in Sivas are their nutrition with more pastry than men, inactivity of women and the most important of them, after birth weight. Therefore, subcutaneous adipose tissue is increased in their waist circumference. After the age of 65, an average value around the waist of both men and women are increased. The average values for waist circumference of 800 mm in women, men should be 940 mm (Tanyolaç et al, 2004). Some anthropometric studies are given similar results compared to other studies. For instance, in Spain, waist circumference average value of 102.8 cm for women age 50-69; 102.6 cm between 70-79 years age; in men, 97.1 cm 60-69 years age; 98.0 cm between 70-79 years age (Fisac et al., 2004). This sample is given similar result in men in our study; while waist measurements of our women samples are greater than mean values.

The most important measures for the determination of body composition are abdominal and pelvis circumferences. The average value of abdominal circumference in men and women after age 65 years is increased. This situation may result from genetic traits in women.

Calf of the leg (Tibia) circumference after the age of 65 was decreased in both sexes (Table 5,6). The lean tissue mass in the body increases with aging and so, melting of fatty tissue under the skin in the thigh increases. Calf of the leg circumferences causes a reduction in size.

4. Conclusion

This anthropometric study in the medical apparatus design can be considered a significant standard to the elderly individuals, especially for the city of Sivas. It cannot be made an assessment for other cities of Turkey. Along with these, these measurements can use in automotive industry, public space design, furniture, the design of objects such as a sofa, workplace design and architectural structures areas and it is important in terms of creating the data source

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