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ANTHROPOMETRY VARIATION DURING RESTING POSITIONS ADOPTED BY BEDRIDDEN AND REDUCED MOBILITY PATIENTS

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ABSTRACT

Users with reduced mobility, who are bedridden or in wheelchairs for long periods, are prone to several changes in the main human body systems. Clothing as an essential item for these users, will be in direct contact with the skin, also for long periods. The adopted posture will influence the interaction with clothing, and consequently, will have an effect on the body. Understanding these body changes, namely the changes in anthropometric measurements according to the adopted posture, becomes relevant, given the impact on total comfort, especially in its ergonomic variable. The objective of this study is to identify, quantify and compare users body changes for the main resting positions adopted throughout their day, as a condition of reduced mobility, in particular in the situation of lying down, in dorsal and/or lateral decubitus, as well as the resting situation in the sitting position.

KEYWORDS

Ergonomic comfort, Anthropometry, Body posture, Body measurements variation.

INTRODUCTION

The movement of the human body is only possible through the joint and coordinated action of bones, muscles and joints. The size of the muscle and its efficiency are directly related to its use or activity, so in users with reduced mobility, there is a tendency to lose body mass and consequently decrease the value of their body measurements. The body at rest for long periods, enhances the action of clothing on the skin. Ergonomic and anthropometric studies have a major impact on the comfort of these people

Bedridden people have specific needs that are directly reflected in the use of clothing. For example, by staying too long in the lateral decubitus position, with the knees flexed and consequently increasing the measurement value, will suffer from the non-accommodation of the ergonomic pattern design and/or textile material.

In general, the construction of clothing is designed for people without limitations, who carry out their daily activities considered within “normality” and who spend most of their time, standing or active. In addition to the poor ergonomic pattern design, misfits related to the assembly of the garments, internal seams, raw material and textile structure used, finishings and trimmings, can pose serious problems to the health of these users [1,2].

The existing anthropometric studies are still far from satisfying the specific groups or target population, since the first and most detailed studies, in terms of anthropometric measurements, were carried out with military populations, in the US and German populations [3]. There are many limitations to apply the data collected from the human body measurements collected in a growing number of anthropometric studies, as their target population differs from the population studied in this study, considering also variables affected by time and space, in addition to the most common dimensioning system, being representative, for the most part, of static postures [4]. Regarding the carried-out studies in terms of comparing body changes between the resting decubitus lying down positions, they are quite deficient or non-existent, with a lack of research focusing on anthropometry and ergonomics.

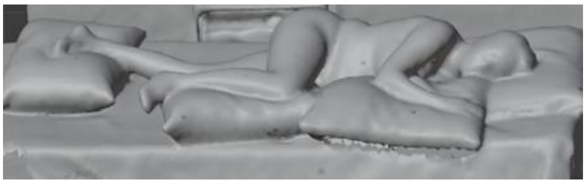
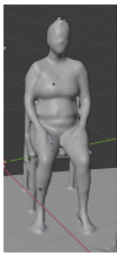
Comparative anatomical studies between the standing and sitting positions were subject of research, noting the existence of changes in body shape and size. For example, the increase in the abdomen and hips when moving to a sitting position [5]. Another factor to be considered is the most appropriate place to measure certain parts of the body, due to the difficulty of identifying girth measurements. For example, the hip region, which can be defined between the waist line and the low hip line, presents complexity due to the variation of body shapes [6]. Knowledge of human anatomy is necessary, particularly to accurately identify the anthropometric points for a closer approximation of the dimensions of the studied body, and from there, design clothing with the collected data [7].

The impact of body measurements from the postural changes of users with reduced mobility, will determine the distortions of clothing related to body movements, restricting or intensifying the comfort condition [8].

For this study, anthropometric measurements were collected from eleven participants, in a geriatric residency and also in a medical and rehabilitation clinic. Participation in the study was voluntary, with the informed consent of the user and/or his/her guardian. The sample of eleven participants is composed of eight females and three males, aged between 55 and 94 years.

MATERIALS AND METHODS

Measurements took place between 12/15/2021 and 01/26/2022 and were carried out by a team composed of two people. Seventeen anthropometric dimensions were defined, and their measurement values recorded in three different resting positions: Supine position (Position 1); Lateral decubitus position (Position 2); and Sitting position (Position 3), according to the representation in Figure 1.

Supine position (Position 1)

Lateral decubitus position (Position 2)

Sitting position (Position 3)

Figure 1. Resting positions used to obtain body measurements.

The seventeen variables selected for the study were defined, considering the main lines of the trunk and body members, with impact on clothing pattern design process. For the direct method, where there is physical contact with the participant, measurements were obtained manually, using a flexible tape measure and a caliper. As for the indirect method, where there is no direct physical contact, three-dimensional images were captured using the 3D Structure scanner and a photographic camera to record and study the resting positions.

The data analysis process was performed using IBM® SPSS Statistics software v27 and Microsoft® Excel 2016 spreadsheet. Data normality was verified using the Shapiro-Wilk test. For the variables that obeyed the normal distribution, the average (Avg) and standard deviation (SD) values were used. On the other hand, for variables that showed a behavior not normally distributed, the median (Md) and the interquartile range (IQR) were used. For the variables that followed the normal distribution, the differences were obtained through the one-sample t-test (with a 95% confidence interval). In the case of variables that followed a non-normal distribution, the one-sample Wilcoxon test was used.

RESULTS AND DISCUSSION

The mean age for women was 83.25 ± 12.54 years and for men 78.00 ± 9.53 years. Table 1 shows the global results of anthropometric data obtained in this study, which include average values (Avg) and standard deviation (SD). From the evaluated body dimensions, five of them had a non-normal distribution, NBC_Dsupine, SB_Sitting, CH_Dlateral, HH_Sitting and SL_Sitting. Regarding the difference between the body dimensions studied (n=17) and the resting positions (n=3), a significant difference was observed between HC_Dsupine and HC_Sitting; KN_Dsupine and KN_Sitting; EC_Dsupine and EC_Dlateral; EC_Dsupine and EC_Sitting; SB_Dsupine and SB_Dlateral; SB_Dsupine and SB_Sitting; SB_Dlateral and SB_Sitting; TFL_Dsupine and TFL_ Sitting; TFL_Dlateral and TFL_Sitting. Of the fifty-one measurements considered (17 dimensions and 3 positions), nine measurements (17.65%) showed changes due to the adopted position.

Table 1 - Anthropometric dimension, abbreviation, Avg and SD considered and collected in this study.

Position	Anthropometric Dimension	Abbreviation	Average	SD
1	Neck base circumference	NBC	410.91	48.90
2	Chest circumference	CC	1021.82	116.21
3	Waist circumference	WC	968.64	143.16
4	Abdomen circumference	AC	1001.82	134.94
5	Hip circumference	HC	1033.18	1055.00
6	Upper thigh circumference	UTC	505.91	518.64
7	Middle thigh circumference	MTC	424.55	68.79
8	Knee circumference	KN	388.64	42.31
9	Upper arm circumference	UAC	310.91	55.46
10	Elbow circumference	EC	261.82	25.13
11	Hand circumference	HC	212.73	20.03
12	Shoulder breadth	SB	110.45	11.48
13	Crotch height	CH	594.09	67.58
14	Outside length (trousers length)	OT	924.55	61.21
15	Hook height	HH	330.45	60.74
16	Sleeve length	SL	591.36	32.75
17	Total front length (Neck-Bust-Waist)	TFL	363.64	42.24

Table 2 Anthropometric dimension, position, Min, Max, Avg, SD, Md and IQR. Measurements are given in mm

	Supine position						Lateral decubitus position						Sitting position					
Variables	Min	Max	Avg	SD	Md	IQR	Min	Max	Avg	SD	Md	IQR	Min	Max	Avg	SD	Md	IQR
NBC	360	500	411	47	390	75	350	480	407	49	390	100	350	480	405	46	385	95
CC	870	1250	1022	124	1010	210	860	1220	1005	116	990	200	890	1340	1054	141	1040	220
WC	770	1230	969	152	990	290	755	1180	969	143	1000	240	790	1290	1024	157	1030	240
AC	820	1210	1002	127	980	210	820	1240	1019	135	1010	250	880	1340	1081	138	1080	160
HC	880	1170	1033	93	1040	160	920	1220	1055	93	1060	115	950	1250	1104	102	1085	180
UTC	340	630	506	96	525	150	365	660	519	99	520	150	380	690	535	104	550	200
MTC	310	520	425	65	445	105	340	550	432	69	445	125	350	555	448	72	450	150
KN	340	450	389	37	380	60	350	470	405	42	400	85	350	500	425	49	400	100
UAC	225	380	311	53	300	90	230	380	312	55	290	110	210	360	297	54	285	90
EC	230	300	262	23	260	50	255	340	292	25	290	25	240	310	278	23	280	40
HC	190	250	213	18	220	20	190	250	213	20	210	30	180	260	211	24	210	35
SB	95	130	110	11	110	20	80	120	98	11	100	15	110	140	119	9	120	10
CH	510	720	594	64	565	100	525	750	607	68	570	100	540	760	618	65	590	100
OT	830	1040	925	65	920	100	860	1050	943	61	930	115	850	1060	941	66	930	105
HH	250	395	330	57	360	110	260	415	336	61	365	130	245	400	323	59	355	115
SL	560	640	591	24	590	40	555	660	595	33	590	35	560	630	587	22	580	30
TFL	280	440	363	44	365	60	310	450	374	42	370	60	210	400	328	49	330	60

Table 2 displays a more detailed anthropometric data organizing by position (Supine, Lateral ecubitus and Sitting position) containing Min, Max, Avg, SD, Md and IQR values. Due to the lack of a significant number of males and females in this sample (males = 3, females=8) the dimensions were not analyzed separately for men and women.

CONCLUSION

The results obtained demonstrate that when posture changes, significant variations occur in the values of the main body measurements, with impact on the clothing pattern design process. Some body measurements showed considerable differences, such as those related to shoulder measurements, between the sitting and lying resting positions. This is due to the positioning adopted by the arms up or down, while in the supine position, and the elbows flexed, while in the lateral decubitus position and in the sitting position, with relevant changes in their angular position, occurring a decrease in the width and distance of the shoulders.

Another notable variation occurred in the measurements of trunk girths, mainly in the hip and abdomen, with an increase in volume when the body assumes the sitting position.

The thigh circumferences (in the upper and middle positions) also showed higher measurement values for the seated position, with muscle mass redistribution by the interference of the support surface.

In the area of the knees and elbows, it was found that due to the flexion of both, required for the adopted resting positions, especially in the lateral decubitus position, there was an increase in the value of the measurements when compared to the other positions. The variable total length of the front, which comprises the distance between the base of the neck and the waist line, showed a considerable change between the three assumed postures.

The significance of the quantified differences, demonstrated in this study, according to the changes in the users' resting postures, and the need to stay for long periods, resulting from their reduced mobility, will have an impact on the interaction between clothing and the body, being directly related to comfort, especially to ergonomic comfort.

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