

# Developing standard size chart for males (18-26 years) through anthropometric survey

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■ **ABSTRACT** : The aim of this study is to establish anthropometric data for *Khadi* industries of Uttarakhand in order to promote *Khadi* stitched garments amongst male youth. Data were collected from all of the geographical regions of Uttarakhand *i.e.*, High hills (>2500 m. altitude), Middle hills (1000-2500 m. altitude) and foothills or plains (<1000 m. altitude). Totally, about 1080 measurements of male students (18-26 years) were collected. Data purging process has been carried out before using it for developing standards. Data collected were analysed using percentile base for the 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile. Based on the percentile, standard size chart was developed. Visible difference has been observed on standards when compared with USA and Italy standards for the same measurements. This proved that further studies should be conducted for other age groups not only in the male but also in the female category.

■ **KEY WORDS**: Males, Anthropometric data, *Khadi* industries, Garments

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Anthropometric data of a country are vital database for clothing design and other design applications. It is also an important parameter in population studies. Anthropometry is the science that measures the range of body size in a population (Dasgupta *et al.*, 2012). Many researchers agree on the needs to measure human body dimensions in order to develop standards and solve body size variations due to number of reasons *viz.*, geographical location, ethnic group, nutrition, etc.

For the promotion of *Khadi* readymade garments amongst youth, sizing standard is a popular issue. As today's young generation are much more conscious about garment fitting while purchasing readymade garments (Taylor, 2000).

Today, numbers of designers are working on designing of *Khadi* garments but still a lot attempt is required. Until, there is no Indian institution which tries to develop the standard size chart specifically for male youth in Uttarakhand. This study is, therefore, an attempt to study male (18-26 years) body dimensions for clothing design.

## ■ RESEARCH METHODS

The male anthropometric measurements were taken manually as per ASTM D 6860-03: 2006 standard. Present research is intended to study all body measurements *viz.*, Stature (cm), Weight (kg), Chest girth (cm), Waist girth (cm), Seat girth (cm), Neck girth (cm),

Thigh girth (cm), Knee girth (cm), Calf girth (cm), Ankle girth (cm), Armscye girth (cm), Upper arm girth (cm), Elbow girth (cm), Wrist girth (cm), Cervical height (cm), Center back to waist line (cm), Center front to waist line (cm), Waist line to seat line (cm), Waist line to crutch line (cm), Crutch line to knee line (cm), Knee line to ankle line (cm), Outside leg (cm), Inside leg (cm), Arm length (cm), Across chest (cm), Across back (cm), Shoulder length (cm), Shoulder slope (degrees), Shoulder width (cm). The study was conducted at Uttarakhand. Based on the above basic measurements for the garments preparation, data were taken from 1080 male students of different universities of Uttarakhand. Data were analysed using EXCEL to check normalities by normality test. Then, based on the purified data 5<sup>th</sup> %, 50<sup>th</sup> % and 95<sup>th</sup> % were computed and standard size charts were also developed for the two garments (upper and lower). Finally, size charts developed were compared with

international size chart to validate in the measurements.

**RESEARCH FINDINGS AND DISCUSSION**

Before interpreting the data, normality test was made using Skewness and Kurtosis tests mainly used to measure asymmetry of distribution and central tendency, respectively (Beshah *et al.*, 2014). If Skewness and Kurtosis ratio to their standard error is between -2 and 2, then the data are assumed to be normally distributed. Table 1 show the final normality test result obtained.

After checking the normality of collected anthropometric data, the purified data were taken to develop frequency distribution. The relative frequency indicates percentile of occurrence in order to find how many times the value of measurement occurs and it helps us to find the proportion of measurements in the particular population occurrence. The main objective of this study is to develop a standard anthropometric data for garment

**Table 1 : Normality test**

Sr. No.	Variables	Mean	Skewness	Kurtosis	Std. error	Ratio test		Remark
						Skewness/ Std. error	Kurtosis/ Std. error	
1.	Stature(cm)	174.41	0.11	-0.11	0.2	0.53	-0.52	Normal
2.	Weight (kg)	69.36	0.44	0.01	0.32	1.36	0.02	Normal
3.	Chest girth	93.92	0.31	0.28	0.25	1.26	1.15	Normal
4.	Waist girth	82.65	0.54	-0.05	0.27	1.96	-0.19	Normal
5.	Seat girth	97.59	0.44	-0.31	0.23	1.91	-1.34	Normal
6.	Neck girth	39.89	0.08	-0.2	0.1	0.82	-2	Normal
7.	Thigh girth	50.93	0.27	-0.18	0.13	2	-1.37	Normal
8.	Knee girth	38.8	0.13	0.04	0.09	1.52	0.48	Normal
9.	Calf girth	36.85	0	0.09	0.09	-0.02	0.95	Normal
10.	Ankle girth	26.38	-0.02	-0.08	0.07	-0.29	-1.19	Normal
11.	Armscye girth	46.29	-0.03	-0.34	0.17	-0.19	-1.96	Normal
12.	Upper arm girth	30.04	0.19	-0.02	0.11	1.75	-0.19	Normal
13.	Elbow girth	27.05	0.07	0.08	0.07	0.92	1.13	Normal
14.	Wrist girth	18.63	-0.08	0.03	0.05	-1.66	0.58	Normal
15.	Cervical height	150.21	0.23	0.17	0.19	1.2	0.92	Normal
16.	Center back to waist line	42.13	-0.18	0.15	0.08	-2	1.93	Normal
17.	Center front to waist line	34.81	0.13	0.04	0.07	1.69	0.6	Normal
18.	Waist line to seat line	24.6	0.15	0.19	0.11	1.35	1.68	Normal
19.	Waist line to crutch line	29.67	0.25	-0.28	0.13	1.86	-2	Normal
20.	Crutch line to knee line	34.7	-0.13	0.25	0.13	-0.99	1.9	Normal
21.	Knee line to ankle line	42.69	-0.02	0.19	0.1	-0.21	1.91	Normal
22.	Outside leg	104.66	-0.18	-0.27	0.16	-1.09	-1.69	Normal
23.	Inside leg	71.75	-0.07	0.04	0.16	-0.43	0.25	Normal
24.	Arm length	58.2	0.12	-0.16	0.1	1.13	-1.58	Normal
25.	Across chest	38.62	0.07	0.17	0.09	0.78	1.8	Normal
26.	Across back	38.48	-0.01	-0.14	0.09	-0.13	-1.54	Normal
27.	Shoulder length	16.43	-0.06	-0.04	0.05	-1.34	-0.85	Normal
28.	Shoulder slope (degrees)	22.76	0.21	0.14	0.12	1.78	1.19	Normal
29.	Shoulder width	44.2	-0.02	0.01	0.07	-0.25	0.15	Normal

design and readymade clothes production. After purging the data frequency distribution has been made to further classify the data. As the anthropometric principles suggest, the target must include design for the smallest and the largest. The size cluster classification is made with 5<sup>th</sup> percentile smallest size groups, 50<sup>th</sup> percentile for medium size groups, and 95<sup>th</sup> percentile for largest size groups. There is an erroneous tendency to consider the 50<sup>th</sup> percentile dimensional data as sufficient to accommodate the majority of users. This must not be done. The 50<sup>th</sup> percentile dimensions accommodate only a portion of the population, not a majority of the users. A person who is 5<sup>th</sup> percentile body size does not necessarily have 5<sup>th</sup> percentile neck or waist circumference dimensional measurements (Beshah *et al.*, 2014). Based

on these basic assumptions, the researcher tries to classify the sample standard into three percentile groups: 5<sup>th</sup> percentile, 50<sup>th</sup> percentile, and 95<sup>th</sup> percentile (Table 2).

The standard design will have letter and size code classifications to make it easy and understandable for the user. All the measurements are grouped into five known clusters: the small size ‘S’ representing the 5<sup>th</sup> percentile population, medium size ‘M, L and XL’ representing the 50<sup>th</sup> percentile populations and large size ‘XXL’ representing the 95<sup>th</sup> percentile population. Tables 3 represent measurement groups in small, medium and large categories.

Size charts developed in present study were also compared with that of America and Italy by considering

**Table 2 : Percentile distribution of all body measurements**

Sr. No.	Variables	Size class n <sup>th</sup> %		
		5 <sup>th</sup> %	50 <sup>th</sup> %	95 <sup>th</sup> %
1.	Stature(cm)	163	175	186
2.	Weight (kg)	54	69	89
3.	Chest girth	82	93	107
4.	Waist girth	70	83	99
5.	Seat girth	86	96	111
6.	Neck girth	35	40	45
7.	Thigh girth	44	51	59
8.	Knee girth	35	39	44
9.	Calf girth	32	37	41
10.	Ankle girth	23	26	30
11.	Armscye girth	38	46	55
12.	Upper arm girth	25	30	36
13.	Elbow girth	24	27	32
14.	Wrist girth	17	19	21
15.	Cervical height	140	150	161
16.	Center back to waist line	37	42	46
17.	Center front to waist line	31	35	39
18.	Waist line to seat line	20	24	32
19.	Waist line to crutch line	24	29	38
20.	Crutch line to knee line	27	35	42
21.	Knee line to ankle line	38	42	49
22.	Outside leg	96	105	114
23.	Inside leg	62	72	80
24.	Arm length	53	58	64
25.	Across chest	34	38	44
26.	Across back	34	39	43
27.	Shoulder length	14	16	19
28.	Shoulder slope (degrees)	16	23	29
29.	Shoulder width	40	44	48

**Table 3 : Size chart**

Sr. No.	Variables	Size codes				
		S	M	L	XL	XXL
1.	Stature(cm)	163	169	175	180.5	186
2.	Weight (kg)	54	61.5	69	79	89
3.	Chest girth	82	87.5	93	100	107
4.	Waist girth	70	76.5	83	91	99
5.	Seat girth	86	91	96	103.5	111
6.	Neck girth	35	37.5	40	42.5	45
7.	Thigh girth	44	47.5	51	55	59
8.	Knee girth	35	37	39	41.5	44
9.	Calf girth	32	34.5	37	39	41
10.	Ankle girth	23	24.5	26	28	30
11.	Armscye girth	38	42	46	50.5	55
12.	Upper arm girth	25	27.5	30	33	36
13.	Elbow girth	24	25.5	27	29.5	32
14.	Wrist girth	17	18	19	20	21
15.	Cervical height	140	145	150	155.5	161
16.	Center back to waist line	37	39.5	42	44	46
17.	Center front to waist line	31	33	35	37	39
18.	Waist line to seat line	20	22	24	28	32
19.	Waist line to crutch line	24	26.5	29	33.5	38
20.	Crutch line to knee line	27	31	35	38.5	42
21.	Knee line to ankle line	38	40	42	45.5	49
22.	Outside leg	96	100.2	105	109.5	114
23.	Inside leg	62	67	72	76	80
24.	Arm length	53	55.5	58	61	64
25.	Across chest	34	36	38	41	44
26.	Across back	34	36.5	39	41	43
27.	Shoulder length	14	15	16	17.5	19
28.	Shoulder slope (degrees)	16	19.5	23	26	29
29.	Shoulder width	40	42	44	46	48

**Table 4 : Comparison among sizes for upper garment**

Size code	Uttarakhand size			American size			Italian size		
	Neck girth (cm)	Sleeve length (cm)	Chest girth (cm)	Neck girth (cm)	Sleeve length (cm)	Chest girth (cm)	Neck girth (cm)	Sleeve length (cm)	Chest girth (cm)
S	35	67*	82*	33	80	85	34	84	90
M	37.5	70.5*	87.5*	36	83	91	37	84	93
L	40	74*	93*	38	85	99	38	87	98
XL	42.5	78.5*	100*	41	88	109	40	91	104
XXL	45	83*	107*	44	90	119	42	91	112

Note: Sleeve length (Shoulder length + arm length)

\*indicates significance of value at P=0.05

**Table 5 : Comparison among sizes for lower garment**

Size code	Uttarakhand size			American size			Italian size	
	Waist girth (cm)	Seat girth (cm)	Inside leg (cm)	Waist girth (cm)	Seat girth (cm)	Inside leg (cm)	Waist girth (cm)	Seat girth (cm)
S	70*	86*	62*	78	94	80	76	93
M	76.5*	91*	67*	86	102	82	80	97
L	83*	96*	72*	94	110	84	84	101
XL	91*	103.5*	76*	102	118	86	88	105
XXL	99*	111*	80*	110	126	88	92	109

\* indicates significance of value at P=0.05

measurements of neck, chest, waist, seat circumference, sleeve length and inner seam as key indicators for male garment (upper and lower) production. From the comparison of the males of Uttarakhand having neck girth measurement somewhat same or slightly different when compared to American and Italian sizes. Whereas, all the other measurements found to be significantly different at 5% level of significance (Table 4 and 5). Size variation may be due to difference in physical structure, heredity, nutrition, region, growth, development and age (Le Pechoux and Ghosh, 2002).

### Conclusion:

As it is shown from the data analysis, the male (18-26 years) size chart has been developed. Despite of anthropometric variability in different geographical location of Uttarakhand, all the collected data was normally distributed. Moreover, the comparison of developed size with European and US standards shows that there is a significant difference for the same neck and waist measurement and other parts of the body measurement. The Italian and US body measurement is generally bigger than the Indian body dimension. This was the problem that creates loose fit garments

manufactured and imported to Indian customers as per the Italian and USA body size standards. It will be helpful for the garment manufacturers intended for Indian customers. In addition to this, it may also be useful for importers or traders of garment for the Indian people.

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