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Research Article

COMPARISON OF ANTHROPOMETRIC DATA OF FEMALE AGRICULTURE WORKERS OF H-K REGION

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Abstract: Women play s significant and crucial role in agricultural development and allied fields. Therefore efforts were made to analyze the work. This study presents comparisons of anthropometric data female agriculture with other state and other countries. Twenty four body dimensions of female agricultural workers and six strength parameters were compared. The mean stature of present study is 2.13 cm and 0.53 cm more than the mean stature of Madhya Pradesh and Kerala respectively. The present study mean stature is less than the 2.37 and 0.88 of Gujarat and Arunachal Pradesh. The female agricultural workers of UAS campus are higher than Madhya Pradesh and Kerala and shorter than Gujarat and Arunachal Pradesh. The present data were also compared with male workers of other states the results revealed that male body dimension is higher than all female workers. The mean stature of female worker is less than 10.65, 9.39, 5.56, 7.54, 0.44 and 3.26 American, British, Chinese, Egyptian, Mexican and Taiwanes. All country stature of female agricultural workers was higher than the data collected from UAS campus Raichur.

Keywords: *Anthropometric data, Body dimensions, Female workers, Strength parameter*

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Introduction

It is clear that anthropometric data are very important for product design and other applications. Anthropometry is the technology of measuring various human physical traits, primarily factors such as size, mobility and strength. Engineering anthropometry is an effort to apply such data to equipment and workplace design to enhance the efficiency, safety and comfort of the operator. Anthropometry is fundamental to successful design of agricultural equipment. It is critical for designer to consider the human being intentionally and thoroughly at the time of conception of the design rather than as a follow up or add-on part of the design. Anthropometric measures vary considerably due to effect of various factors. Gender, race and age are the prime factors that play a dominant role in this variability. In India, agricultural equipment is not designed ergonomically for the users' population due to limited availability of anthropometric data and thus subjected to different operations and reduction in overall performance efficiency. At present very few studies are available on collection of anthropometrical data on women agricultural workers of the country. Studies have been reported for collection of anthropometric data on Indian agricultural workers most of them are confined to male agricultural workers [10, 8, 22, 5] Studies have been reported for collection of anthropometric data on Indian female agricultural workers [7, 21, 4] Till now no effort have been made to collect anthropometric data and strength parameters of female agricultural workers of Karnataka India (Raichur). Keeping these points into consideration, anthropometric and strength data of female agricultural workers were identified, compiled and analyzed to build the data bank to be used in the design of agricultural implements/machines to match the limitation, capabilities and power of female farmer and also in work place design.

For the scientific design of agricultural tools an anthropometric database is a prerequisite. The marginal and small farmers of India extensively use various hand tools like *Khurpi* (interculture tool). Based on the anthropometric considerations, length of handle, handle diameter for better grip can be considered. During pushing operation of wheel hoe, the blade uproots the weeds. The wheel hoe is brought back by the pull action. The handle of the wheel hoe should be designed such that during operation the operator stands erect as far as possible to reduce musculoskeletal discomfort. The optimum length of handle can be considered from the geometry adopted by the female operator. Further grip of the handle, inclination of the handle and height from the ground should consider so as to suiting the agricultural female worker. Therefore, the aim of this study was to compare the differences in anthropometric dimensions of H-K region agriculture female workers with other state and country.

Materials and Methods:

Fabrication of anthropometer

To measure anthropometric parameters the anthropometer was fabricated in College of Agricultural Engineering Raichur. Anthropometer consists of standing platform, measuring scale, sitting chair are shown in [Fig-1].

Fig-1 A view of anthropometer

Table-1 Comparison of anthropometric data of present study with female agricultural workers of Madhya Pradesh, Kerala, Gujarat and Arunachal Pradesh

SN	Dimensions	Present Study♠	Madhya Pradesh♥	Kerala ♣	Gujarat◘	Arunachal Pradesh ♦
1	Weight (Kg)	47.13(±7.76)	45(±7.3)	46.6(±7.4)	49.5(±5.25)	48.01(±4.38)
2	Stature	153.06(±4.92)	151.9(±1.71)	147.3(±6.8)	154.6(±6.18)	153.25(±5.50)
3	Standing eye height	141.98(±5.57)	141.3(±1.64)	140.4(±5.6)	145.3(±5.05)	141.76(±5.16)
4	Standing shoulder height	127.90(±5.56)	126.5(±1.55)	124.6(±7.7)	127.5(±4.86)	127.09(±4.27)
5	Standing elbow height	97.52(±4.06)	NA	73.6(±13.5)	97.3(±6.68)	96.18(±4.22)
6	Olecranon height	96.60(±3.46)	NA	NA	NA	94.11(±3.98)
8	Standing knee height	44.86(±2.21)	43.5(±0.73)	45.6(±3.1)	NA	41.21(±2.43)
9	Arm reach from the wall	80.83(±7.01)	NA	NA	76.4(±3.63)	73.12(±3.05)
10	Forearm hand length	42.09(±2.07)	42.5(±0.63)	41.4(±1.95)	NA	40.70(±1.71)
11	Span	155.09(±5.22)	155.1(±2.02)	NA	NA	NA
12	Sitting height	78.11(±3.33)	77.6(±0.95)	NA	76.9(±2.45)	80.28(±3.44)
13	Sitting eye height	67.72(±2.98)	NA	NA	65.2(±2.10)	68.74(±2.78)
14	Sitting elbow rest height	20.59(±1.29)	NA	NA	17.8(±1.38)	23.39(±2.29)
15	Sitting popliteal height	41.16(±1.29)	NA	NA	39.8(±2.14)	35.31(±1.86)
16	Hand length	17.01(±1.21)	18.2(±0.28)	17.3(±2.1)	16.5(±1.28)	16.53(±0.73)
17	Hand breadth	8.54(±0.95)	13.8(±0.28)	5.1(±1.3)	7.8(±0.76)	6.49(±0.30)
18	Palm length	9.56(±1.03)	NA	NA	NA	9.11(±0.43)
19	Grip diameter (inside)	4.55(±0.34)	NA	NA	3.8(±0.22)	4.35(±0.28)
20	Grip span	7.06(±0.76)	NA	NA	NA	5.93(±0.57)
21	Maximum grip length	11.20(±2.04)	NA	NA	NA	9.10(±0.48)

Dimensions are in cm, unless specified. ♠Data are Mean (±SD) [♥1,♣7,◘20, ♦4]

Table-2 Comparison of stature ratio of present study with female agricultural workers of Madhya Pradesh, Kerala, Gujarat and Arunachal Pradesh

SN	Dimensions	Stature Ratio				
		Present Study♠♠	Madhya Pradesh♥	Kerala ♦	Gujarat*	Arunachal Pradesh ♠
1	Weight (Kg)	0.31	0.30	0.32	0.32	0.31
2	Stature					
3	Standing eye height	0.93	0.93	0.95	0.94	0.93
4	Standing shoulder height	0.84	0.84	0.85	0.82	0.83
5	Standing elbow height	0.64	0.63	0.50	0.63	0.63
6	Olecranon height	0.63	NA	NA	NA	0.61
7	Standing waist height	0.62	NA	NA	NA	0.58
8	Standing knee height	0.29	0.29	NA	NA	0.27
9	Arm reach from the wall	0.53	NA	NA	0.49	0.48
10	Forearm hand length	0.27	0.28	NA	0.27	0.27
11	Shoulder grip length	0.42	NA	NA	0.31	0.36
12	Sitting height	0.51	0.51	NA	0.50	0.52
13	Sitting eye height	0.44	NA	NA	0.42	0.45
14	Sitting popliteal height	0.27	NA	NA	0.26	0.23
15	Sitting elbow rest height	0.13	NA	NA	0.12	0.15
16	Hand length	0.11	0.12	0.12	0.107	0.11
17	Hand breadth	0.06	0.09	0.03	0.05	0.04
18	Palm length	0.06	NA	NA	NA	0.06
19	Grip diameter (inside)	0.03	NA	NA	0.02	0.03
20	Grip span	0.05	NA	NA	NA	0.04
21	Maximum grip length	0.07	NA	NA	NA	0.06

All dimensions are in cm, unless specified. [♥1, ♣7, ◘20, ♦4]

Table-3 Comparison of selected body dimensions of present study with female agricultural workers of other countries

SN	Dimensions	Present Study ♠♠	American[a]	British[b]	Chinese[c]	Egyptian[d]	Mexican[e]	Taiwanes[f]
1	Stature	153.06(±4.92)	163.71(±6.21)	162.45 (±5.50)	158.62 (±5.13)	160.60(±7.18)	153.50(±5.50)	156.32 (±2.32)
2	Standing eye height	141.98(±5.57)	NA	NA	148.03 (±7.60)	149.20(±6.98)	142.80 (±5.60)	144.98 (±5.24)
3	Standing shoulder height	127.90(±5.56)	135.40(±5.95)	NA	132.03 (±6.10)	130.6 (±5.99)	NA	128.02 (±4.74)
4	Standing elbow height	97.52(±4.06)	102.34 (±4.52)	NA	NA	95.50 (±4.35)	95.60 (±3.80)	97.33 (±3.71)
5	Arm reach from the wall	80.83(±7.01)	NA	NA	78.54(±3.80)	81.40 (±5.03)	NA	75.44 (±3.50)
6	Forearm hand length	42.09(±2.07)	45.05(±3.18)	42.68(±1.83)	NA	41.20 (±2.60)	41.50 (±1.90)	NA
7	Sitting height	78.11(±3.33)	NA	NA	84.85(±3.16)	83.80 (±4.30)	NA	84.48 (±3.00)
8	Sitting eye height	67.72(±2.98)	NA	75.97(±2.90)	75.3(±2.08)	74.30 (±4.06)	NA	73.20 (±2.99)
9	Sitting popliteal height	41.16(±1.29)	NA	NA	38.27(±2.08)	NA	NA	NA
10	Sitting elbow rest height	20.59(±1.29)	NA	NA	23.86(±2.66)	19.70 (±1.16)	NA	NA
11	Hand length	17.01(±1.21)	NA	NA	NA	17.1 (±1.24)	16.90 (±0.90)	NA

Measuring units is cm unless specified. ♠♠Data are Mean (±SD) [[a]13,[b]11,[c]17,[d]14,[e]12,[f]19]

Measurement of body dimensions and strength parameters

Twenty four body dimensions including weight of the subject were identified and selected for the study listed. Body dimensions were measured with an anthropometer. The body dimensions and strength parameters were selected keeping in to consideration for design requirements of hand tools, animal drawn equipment, tractors, power operated machines *etc*., and work place (9). Six strength parameters were identified and selected for the study. Strength parameters were measured with grip dynamometer. These parameters were selected based on the design of various agricultural equipment particularly for weeding.

Table-4 Comparison of stature ratio of present study with female agricultural workers of other countries

SN	Dimensions	Stature Ratio						
		Present Study▲▲	American[a]	Britsh[b]	Chinese[c]	Egyptian[d]	Mexican[e]	Taiwanes[f]
1	Stature							
2	Standing eye height	0.93	NA	NA	0.93	0.93	0.93	0.93
3	Standing shoulder height	0.84	0.83	NA	0.83	0.81	NA	0.82
4	Standing elbow height	0.64	0.63	NA	NA	0.60	0.62	0.62
5	Arm reach from the wall	0.53	NA	NA	0.50	0.51	NA	0.48
6	Forearm hand length	0.27	0.28	0.26	NA	0.26	0.27	NA
7	Sitting height	0.51	NA	NA	0.53	0.52	NA	0.54
8	Sitting eye height	0.44	NA	0.47	0.47	0.46	NA	0.47
9	Sitting Popliteal height	0.27	NA	NA	0.24	NA	NA	NA
10	Elbow rest height	0.13	NA	NA	0.15	0.12	NA	NA
11	Hand length	0.11	NA	NA	NA	0.11	0.11	NA

All the body dimensions are in cm unless specified.[[a]13,[b]11,[c]17,[d]14,[e]12,[f]19]

Table-5 Comparison of selected anthropometric data of female agricultural workers of present study with male agricultural workers of different regions of India

SN	Dimensions	Present Study ▲▲	Madhya Pradesh♣♣	Rajasthan♦	Gujarat●	Eastern India*	North Eastern India ♥	Southern India **	Central India♠	Western India ♣
1	Weight (Kg)	47.13(±7.76)	51.2(±6.4)	53.04(±9.15)	61.2(±15.17)	53.6(±6.73)	NA	56.6(±5.14)	49.3(±5.95)	NA
2	Stature	153.06(±4.92)	164.9(±1.87)	166.67(±5.97)	167(±7.48)	162.1(±5.8)	164.87(±4.54)	160.7(±6.0)	160(±4.95)	164.40
3	Standing eye height	141.98(±5.57)	155(±1.87)	155.90(±6.26)	156.72(±7.33)	150.8(±5.1)	153.55(±5.00)	149.7(±6.1)	151(±5.22)	NA
4	Standing shoulder height	127.90(±5.56)	137.6(±1.77)	139.68(±5.50)	NA	131.2(±4.8)	134.47(±4.30)	130.1(±4.6)	134.6(±4.87)	NA
5	standing elbow height	97.52(±4.06)	104.8(±1.42)	105.29(±5.39)	106.38(±4.96)	101.8(±3.8)	101.91(±3.56)	98.9(±3.8)	102.6(±2.89)	NA
6	Olecranon height	96.60(±3.46)	NA	103.29(±4.86)	NA	NA	98.64(±3.40)	NA	NA	NA
7	Standing knee height	44.86(±2.21)	47.1(±0.73)	NA	NA	NA	45.07(±2.42)	NA	NA	NA
8	Arm reach from the wall	80.83(±7.01)	NA	82.89(±4.54)	83.84(±4.8)	82.8(±3.9)	NA	NA	83.1(±3.9)	NA
9	Forearm hand length	42.09(±2.07)	NA	NA	NA	44.60(±1.96)	43.20(±1.97)	40.10(±2.50)	NA	NA
10	Span	155.09(±5.22)	170.7(±2.25)	NA	NA	NA	NA	NA	NA	NA
11	Sitting height	78.11(±3.33)	84.5(±1.04)	85.22(±4.36)	81.56(±4.69)	80.9(±2.2)	84.70(±2.88)	79.1(±4.0)	NA	86.20
12	Sitting eye height	67.72(±2.98)	NA	73.42(±4.19)	72.02(±4.59)	71.4(±2.0)	73.38(±3.17)	70.3(±4.6)	NA	NA
13	Sitting popliteal height	41.16(±1.29)	NA	43.52(±2.29)	NA	42(±1.74)	41.25(±2.56)	47.1(±3.5)	NA	42.00
14	Sitting elbow rest height	20.59(±1.29)	NA	21.97(±2.45)	NA	17.5(±1.58)	NA	15.4(±0.60)	NA	NA
15	Hand length	17.01(±1.21)	18.7(±0.25)	19.052(±1.07)	18.58(±1.08)	17.8(±1.61)	17.95(±0.56)	16.4(±1.4)	NA	19.10
16	Hand breadth	8.54(±0.95)	14.2(±0.25)	8.291(±0.52)	9.06(±0.66)	NA	8.59(±0.44)	NA	NA	NA
17	Palm length	9.56(±1.03)	NA	11.01(±0.63)	10.5(± 0.58)	NA	9.95(±0.34)	NA	NA	NA
18	Grip diameter (inside)	4.55(±0.34)	NA	5.04(±0.37)	NA	NA	4.77(±0.30)	NA	NA	NA

Measuring units is cm unless specified. ▲▲Data are Mean (±SD)[♣♣1, ♦15,•21, *22, **6, ♠10, ♥5, ♣16]

Table-6 Comparison of female stature ratio of present study with male agricultural workers of different regions of India

SN	Dimensions	Stature Ratio								
		Present Study▲▲	Madhya Pradesh♣♣	Rajasthan♦	Gujarat●	Eastern India*	North Eastern India ♥	Southern India **	Central India♠	Western India♣
1	Weight(Kg)	0.31	0.31	0.32	0.37	0.33	NA	0.35	0.31	NA
2	Stature									
3	Standing eye height	0.93	0.94	0.94	0.94	0.93	0.93	0.93	0.94	NA
4	Standing shoulder height	0.84	0.83	0.84	0.84	0.84	0.82	0.84	0.84	NA
5	Standing elbow height	0.64	0.64	0.63	0.64	0.63	0.62	0.62	0.64	NA
6	Olecranon height	0.63	NA	0.62	N.A	N.A	0.60	N.A	NA	NA
7	Standing knee height	0.29	0.28	NA	NA	NA	0.27	NA	NA	NA
8	Arm reach from the wall	0.53	NA	0.50	0.5	0.51	NA	N.A	0.52	NA
9	Forearm hand length	0.27	0.28	NA	NA	NA	0.26	NA	NA	NA
10	Span	1.01	1.03	NA	NA	NA	NA	NA	NA	NA
11	Sitting height	0.51	0.51	0.51	0.49	0.5	0.51	0.49	NA	0.52
12	Sitting eye height	0.44	NA	0.44	0.43	0.44	0.45	0.44	NA	NA
13	Sitting popliteal height	0.27	NA	0.26	N.A	0.26	0.25	0.29	NA	0.27
14	Sitting elbow rest height	0.13	NA	0.13	0.11	0.11	NA	0.1	NA	NA
15	Hand length	0.11	0.11	0.11	0.11	0.11	0.12	0.1	NA	0.12
16	Hand breadth	0.06	0.09	0.05	0.05	N.A	0.05	N.A	NA	NA
17	Palm length	0.06	NA	0.07	0.06	N.A	0.06	N.A	NA	NA
18	Grip diameter (inside)	0.03	NA	0.03	0.03	0.03	0.03	N.A	NA	NA

All the body dimensions are in cm unless specified. [♣♣1, ♦15,•21, *22, **6, ♠10,♥ 5, ♣16]

Table-7 Comparison of strength parameters of present study with female agricultural workers of Madhya Pradesh, Arunachal Pradesh and Tamil Nadu

SN	Parameters	Present study ♠♠	Madhya Pradesh *	Arunachal Pradesh ♣	Tamil Nadu ♦
1	Hand grip strength (right)	238.35(±61.15)	214.7± 70.3	202.86±82.32	276.05±70.71
2	Hand grip strength (left)	166.88(± 42.29)	183.8 ±69.0	176.4±68.6	274.43±74.15
3	Push strength with both hands in standing posture	200.52(±33.74)	175.5 ±33.9	190.12±68.6	130.34±31.48
4	Pull strength with both hands in standing posture	176.23(±37.12)	159.4 ±42.9	153.86±43.12	168.59±42.94
5	Right hand pull strength in sitting posture	136.42(±39.13)	67.2 ± 17.9	114.66±50.96	137.38±30.44
6	Left hand pull strength in sitting posture	128.04(±45.94)	52.9 ± 13.6	111.72±40.18	139.26±33.04

All parameters are in Newton, unless specified. ♠♠Data are Mean (±SD)[*19,♣3,♦2]

Anthropometric measurements

One of the female subjects was asked to stand on electronic weighing balance. Her weight was accurately recorded. The subject was then asked to stand on standing platform of the anthropometer (standing posture) and her stature, eye height, elbow height, olecranon height, and knee height and arm reach from wall, shoulder height, elbow height, waist height, fore arm hand length, span, span akimbo, thumb tip reach, shoulder grip length were measured with scales and the subject was then asked to sit on the chair on platform of anthropometer for measurement in sitting posture. In this position, observations on sitting height, eye height, popliteal height and elbow rest height with the help of a measuring scale were measured. Subject's hand length, hand breadth, palm length, fore arm hand length, grip span and maximum grip length were measured with the help of Vernier calliper. Grip diameter (inside) was measured with the help of grip measuring device and Vernier calliper. All this procedure was repeated for all the fifty subjects. The collected anthropometrical data of 50 female agricultural workers were statistically analyzed. Range, mean, standard deviation, standard error, coefficient of variation, coefficient of correlation, 5th, 95th percentile and their difference and stature ratio was found for each body dimension. The 5th and 95th percentile was calculated as follows:

$$5^{th} \text{ Percentile} = \text{Mean} - K_2 \times \text{SD} \quad \ldots (1)$$

$$95^{th} \text{ Percentile} = \text{Mean} + K_2 \times \text{SD} \quad \ldots (2)$$

Where,

SD = Standard Deviation

K_2 = 1.645 (Constant for 5th and 95th percentile) [9]

The percentile values can be used to design new agricultural equipment and modify the existing equipment to suit female work force and also for work place design.

Measurement of strength parameters

One of the subjects was asked to stand erect with her arms hanging downwards. She was asked to hold the grip dynamometer tightly in her right hand. The maximum force in Newton was recorded. Similar procedure was followed for left hand. Pull and push force was measured when applied maximum force on dynamometer which is fixed to wall in standing posture by both hands. One of the subject was asked to stand erect with both her arms to hold grip dynamometer which was fixed to wall when subject apply maximum pulling force on it that the pulling strength was recorded and in same way pushing strength was recorded. In same way pulling strength of right hand and left hand were recorded in sitting posture. The measurements were taken for whole sample size. The collected strength data of 50 female agricultural workers were statistically analyzed. Range, mean, standard deviation, standard error, coefficient of variation, coefficient of correlation, 5th, 95th percentile and their difference and stature ratio was found for each body dimension. The 5th and 95th percentile was calculated as given in equation 1 and 2.

Results and Discussion

Comparison of present study to other state and countries study

The present study of anthropometric data of female agricultural workers of UAS Raichur campus were compared with before study of anthropometric data of female agricultural workers of other state Madhya Pradesh, Kerala, Gujarat and Arunachal Pradesh shown in [Table-1]. The mean stature and weight of female agricultural workers of the present study was found to 153.06 (± 4.92) and 47.13 (± 7.76) respectively. The mean stature and weight of other state Madhya Pradesh, Kerala, Gujarat and Arunachal Pradesh were 151.9 (± 1.71) and 45 (± 7.3), 147.3 (± 6.8) and 46.6 (± 7.4), 154.6 (± 6.18) and 49.5 (± 5.25), 153.25 (± 5.50) and 48.01 (± 4.38) respectively. The stature and weight of female workers of present data is more than the Madhya Pradesh and Kerala and present data is less than Gujarat and Arunachal Pradesh. Stature ratio of the present study was compared with the data available for Madhya Pradesh, Kerala, Gujarat and Arunachal Pradesh. These are presented in [Table-2] it can be seen that almost similar stature ratios were obtained. The collected anthropometric data and stature ratio of female agricultural workers of present study was compared with other countries [Table-3]. The mean stature of American, British, Chinese, Egyptian, Mexican and Taiwanese was 163.71(±6.21), 162.45(±5.50), 158.62 (±5.13), 160.60(±7.18), 153.50(±5.50) and 156.32(±2.32) respectively and it was found that present data is lower than the other countries data. [Table-4] presents stature ratio of the present study with the countries of selected body dimensions. The Table show almost similar stature ratio of selected body dimensions. The present female anthropometric data is compared between anthropometric data of male agricultural workers of Madhya Pradesh, Rajasthan, Gujarat, Eastern India, North Eastern India, Southern India, Central India and Western India shown in [Table-5]. The mean stature of female agricultural workers of the study was found to be lower than Rajasthan, Gujarat, Eastern India, North Eastern India, Southern India, Central India and Western India were 164.9(±1.87), 166.67(±5.97), 167(±7.48), 162.1(±5.8), 164.87(±4.54), 160.7(±6.0), 160(±4.95) and 164.40 respectively. The mean weight of the present study was lower than the Madhya Pradesh Rajasthan, Gujarat, Eastern India, Southern India and Central India were 51.2(± 6.4), 53.04(±9.15), 53.04(±9.15), 61.2(±15.17), 53.6(±6.73), 56.6(±5.14) and 49.3(±5.95) respectively. Stature ratio of the present study was compared with the data available for Rajasthan, Gujarat, Eastern India, North Eastern India, Southern India, Central India and Western India they are presented in [Table-6]. The [Table-6] shows almost similar stature ratios. [Table-7] shows comparison between strength parameters of present study and the study conducted for female agricultural workers of Madhya Pradesh, Arunachal Pradesh and Tamil Nadu. The mean right and left hand grip strength of female agricultural workers of the study was found 238.35 (± 61.15) N and 166.88 (± 42.29) N is lower than Tamil Nadu 276.05 (± 70.71) N and 274.43 (±74.15) N respectively and present study is higher than Madhya Pradesh, Arunachal Pradesh 214.7 (± 70.3) N, 183.8 (± 69.0) N and 202.86 (± 82.32) N, 176.4 (± 68.6) N respectively.

Conclusion

The study presents a useful compilation of the selected anthropometric and strength data of female agricultural workers of the region. These data could be used in designing new and modifying existing agricultural equipment developed in other parts of the country and even other countries to suit human capabilities and limitations of agricultural workers in India. Since female participation in various agricultural operations is increasing at a faster rate in various states of the country and in this region, greater stress should be given to develop new tools and machinery suitable for capabilities and limitation of female agricultural workers. In addition agricultural equipment available for male operators may be redesigned or modified to suit female limitations. Further taking into consideration the range of 5th and 95th percentile of the selected body dimensions adjustable design could be made and range of adjustments may be provided.

Application of research: Anthropometric data of female agricultural workers are used for designing of all farm machinery like weeders, harvesters, planters, tractors and improved ergonomics can increase productivity, efficiency and reduce errors and accidents.

Research Category: Ergonomics

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