

Research Paper :

## Anthropometric data of agricultural workers for suggesting demensions of manually operated weeder

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### ABSTRACT

In the vidharbh region of Maharashtra state, most of the agricultural operations are performed manually with the help of traditional tools (*Khurpi*). Use of improved tools and machinery is very low due to inherited constraints like difficult terrain, wide variation in slopes and altitude's, land tenure systems and cultivation practices. At present traditional hand tools and equipments being used in the Vidharbh region are manufactured by the local artisans and small scale manufacturers without application of ergonomic considerations. Thus, a study was undertaken to suggest a dimensions of manually operated weeder on anthropometric data of the agricultural workers of Maharashtra State. Present investigation was undertaken in Vidharbh Region of Maharashtra State during 2010-2011. Total 2500 subjects were selected randomly from five districts of Vidharbh region of Maharashtra State, from each district 500 subjects were selected randomly. Altogether, 19 body parameters useful for manually operated weeder design were selected for the study. Data had been analyzed for mean, standard deviation, 5<sup>th</sup> percentile value, and 95<sup>th</sup> percentile values to be used in weeder design. Different body dimension to stature ratio was also calculated and compared with other studies. Anthropometric data of agricultural workers of Maharashtra was significantly different than the other regions of the country. Present anthropometric data of agricultural workers could be useful in design and development of manually operated weeder.

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Anthropometry is the technique of measuring various human physical traits like size, mobility and strength. Engineering antropometry is the effort to apply such data for the design of equipments or drudgery reducing technology in agriculture to enhance the system efficiency, safety and comfort to the workers. The designer to consider the physical dimensions and designing of farm equipments for better output and safety (Gite, 2000). Singh (1992) showed that anthropometric body dimensions vary from region to region due to gender, race and age. Within a particular group also the variation is seen in anthropometry due to nutritional status and nature of work. To achieve better efficiency along with better comfort and safety to the operater, it is necessary to develop equipments and workplace keeping in view of the anthropometric data of workers. India being an agrarian economy has a very large population performing various types of strenuous activities under varying environmental conditions. Therefore, development of manually operated weeder with the help of anthropometric

parameters is very important thing in agriculture (Gupta, 1981).

In Vidharbh region of Maharashtra most of the weeding operations are performed manually and with indigenous hand tools like "Khurpi" and spade. In Vidharbh region of Maharashtra, there is decrease in the agricultural productivity than other regions due to traditional methods of weeding. One of the main reasons of decreasing the productivity is the use of traditional method for weeding. At present, traditional hand tools and equipments being used in the Vidharbh region are manufactured by the local artisans and small scale manufacturers without application of ergonomic considerations. Weeder developed with the help of ergonomic considerations automatically increase the productivity and efficiency of agricultural workers. Hence, it becomes necessary to study the anthropometric measurements of agricultural workers which could be used as reference data in ergonomical development of manually operated weeder. Present investigation focuses on the anthropometric measurements of agricultural

workers in order to suggest the dimensions of manually operated weeder.

### EXPERIMENTAL PROCEDURE

The investigation was undertaken in five districts, namely Nagpur, Amravati, Buldhana, Yavatmal and Washim situated in Vidharbh region of Maharashtra state. Five hundred agricultural workers were selected randomly from each district totally up to 2,500 agricultural workers of age group ranging from 20-60 years, out of which 1,000 were female and 1500 were male agricultural workers.

#### Measuring equipments:

Apart from a weighing machine having accuracy of 100 g and capacity of 120 kg, measuring tapes and vernier calipers, a wooden conical shape device for measuring grip diameter and an anthropometric meter was used for measurements of anthropometric data.

#### Measuring procedure:

All the measurements were recorded during the year 2010-2011. Measurements were taken up by a group consisting of five agricultural servants from each district. Body dimensions of the subjects were measured from the right hand side and data on female workers were collected by the women Agricultural servant. For those measurements where it was relevant, the head was positioned in the Frankfurt Horizontal Plane as described

by Lohman *et al.* (1988).

While measurements of dimensions in standard posture, the subjects were standing erect with the weights equally distributed on both feet, whereas in sitting position the knee and hip angles were controlled to be about 90 degree.

A proforma was developed for the sequence of measurement of different parameters with minimum change of posture. Before starting the measurements, the different tools and techniques were standardized to reduce both inter and intra investigator variability to a minimum. During the data collection, two independent measurements were performed for each dimension and subject and if the difference between the two exceeded the acceptable level, then the third measurement was performed to exclude the extreme recording. The internal grip diameter was measured using a wooden cone made for this purpose.

### OBSERVATIONS AND ANALYSIS

During the anthropometric survey, it was observed that females were the main workforce for the agriculture in Vidharbh region of Maharashtra State. Most of the agricultural operations except few namely ploughing and puddling are carried out by the female agricultural workers. In the beginning of the survey, it was decided to keep the sample size as 70:30 (male: female). But keeping in view of their participation in weeding operations, sample size

**Table 1: Anthropometric data of agricultural workers in Vidharbh region of Maharashtra state (n= 2500, Age group = 20-60 years)**

Sr. No.	Body dimensions	Mean	S.D.	5 <sup>th</sup> percentile	95 <sup>th</sup> percentile
1.	Age (years)	38.34	9.74	22.32	54.36
2.	Weight (Kg)	55.25	9.73	39.24	71.26
3.	Stature (cm)	163.12	6.49	152.44	173.66
4.	Eye height (cm)	152.88	6.55	142.10	163.66
5.	Acromial height (cm)	137.75	5.81	128.20	147.31
6.	Elbow height (cm)	102.84	6.54	92.09	113.59
7.	Olecranon height (cm)	100.80	5.67	91.48	110.12
8.	Iliocrystale height (cm)	98.42	5.25	89.79	107.05
9.	Trochanteric height (cm)	83.79	5.01	75.54	92.04
10.	Arm reach from the wall (cm)	83.32	4.44	76.02	90.62
11.	Elbow rest height (cm)	19.61	2.09	16.18	23.05
12.	Functional leg length (cm)	93.02	3.61	87.08	98.96
13.	Elbow grip length (cm)	35.66	2.43	31.66	39.65
14.	Hand length (cm)	17.68	1.28	15.58	19.78
15.	Hand breadth at metacarpal –III (cm)	8.26	0.45	7.52	9.00
16.	Hand thickness at metacarpal –III (cm)	2.25	0.31	1.74	2.77
17.	Palm length (cm)	9.76	2.14	6.25	13.28
18.	Instep length (cm)	17.99	1.17	16.07	19.91
19.	Grip diameter (inside) (cm)	5.07	0.51	4.24	5.91

**Table 2: Physical characteristics of the respondent according to age groups (n= 2500)**

Sr. No.	Age (yr)	No. of respondents	Mean height (cm)	Mean weight (kg)	Mean BMI	Remarks
1.	20-30	575(23)	150.55	48.66	21.46	Normal
2.	30-40	815(32.6)	154.87	47.77	19.91	Normal
3.	40-50	620(24.8)	155.40	56.62	23.44	Normal
4.	50-60	490(19.6)	163.12	62.85	23.62	Normal

(Figures in parenthesis indicate percentage)

**Total 3: Comparison of anthropometric data with other parts of the country**

Sr. No.	Body dimensions	Maharashtra	Mizoram*	Gujarat**	Meghalaya***
1.	Weight (kg)	55.25	57.4	61.2	54.2
2.	Stature (cm)	163.12	160.9	167.9	159.8
3.	Eye height (cm)	152.88	150.66	156.82	148.12
4.	Acromial height (cm)	137.75	135.53	142.12	133.25
5.	Elbow height (cm)	102.84	100.62	107.55	98.62
6.	Olecranon height (cm)	100.80	98.58	105.52	96.57
7.	Iliocrystale height (cm)	98.42	96.2	103.10	94.35
8.	Trochanteric height (cm)	83.79	81.57	88.19	79.82
9.	Arm reach from the wall (cm)	83.32	81.1	88.22	79.35
10.	Elbow rest height (cm)	19.61	17.39	18.8	14.2
11.	Functional leg length (cm)	93.02	94.0	95.02	99.9
12.	Elbow grip length (cm)	35.66	35.9	38.7	31.9
13.	Hand length (cm)	17.68	17.26	18.06	17.2
14.	Hand breadth, at metacarpal-III (cm)	8.26	8.04	9.10	7.12
15.	Hand thickness at metacarpal-III (cm)	2.25	2.32	2.82	2.29
16.	Plam length (cm)	9.76	9.96	10.10	8.95
17.	Instep length (cm)	17.99	17.01	19.00	17.6
18.	Grip diameter (inside) (cm)	5.07	4.7	5.25	8.1

\* Prasad *et al.* (1999) \*\* Yadav *et al.* (2000) \*\*\* Singh *et al.* (2005)

increased to almost equal. Various body dimensions measured during the study and the mean, standard deviation, 5<sup>th</sup> percentile and 95<sup>th</sup> percentile values of important anthropometric parameters of agricultural workers has been presented in Table 1.

Table 2 shows that 32.6 per cent respondent belonged to the age group of 30-40 years. The mean height (163.12 cm) was found belonging to the age group of 50-60 years, followed by 155.40 cm from the age group of 40-50 years, 154.87 cm from the age group of 30-40 years, and 150.55 from the age group of 20-30 years. The highest mean body weight of the respondents was 62.85 kg belonged to the age group of 50-60 years which was followed by respondents with mean weight 56.62 kg belonged to the age group of 40-50 years. It was found that BMI of the respondents belonging to the age group of 50-60 years had highest mean score (23.62) and all the respondents were having the normal BMI.

Table 3 shows the comparison of anthropometric data with other parts of the country. Average anthropometric

data of Maharashtra agricultural workers is lower than Gujarat agricultural workers and greater than anthropometric data of Mizoram and Meghalaya agricultural workers is changing from different states in India. That's why design and development of manually operated weeder is different for every state of India.

These recommended specifications were useful for design and development of manually operated weeder (Table 4).

**Table 4 : Recommended specifications for development of manually operated weeder**

Sr. No.	Specifications	Measurement
1.	Length	140 cm
2.	Width	70 cm
3.	Height	50 cm
4.	Weight	7.2 kg
5.	Diameter of wheel	40 cm
6.	Height of handle from ground	95 cm

**Conclusion:**

Anthropometric data of agricultural workers of Maharashtra was significantly different than their counterparts from other regions of the country. Women's participation in various agricultural operations in the Maharashtra state is relatively more than other parts of country so, there is greater need to develop improved tools and equipment suiting the capabilities of agricultural workers. The present anthropometric data could be useful in design and development of manually operated weeder especially suitable for the agricultural workers of the Vidharbh region of Maharashtra State.

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