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Original Article

The Evaluation of the Most Important Anthropometric Variables of Tribal Women of Banswara District, Rajasthan (India)

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ABSTRACT

Indian tribals are a heterogeneous ethnic group. They are at the lowest stratum of the society due to geographical and cultural isolation, low levels of literacy, high levels of poverty etc. This study was conducted to evaluate the most important anthropometric variables of tribal women. Anthropometric measurements (like body weight, height, triceps and subscapular skinfold thickness, mid arm circumference, hip and waist circumference, thigh circumference and calf circumference) represent an important component of nutritional assessment of women. Body measurements also show direct relation with health and nutritional status. Circumferential measurements and skinfold thickeness were found to be better predictor of body fat. A wide variation in skin fold thickness would be attributed to the varied nutritional status. Overall extent of undernutrition (BMI <18.5)was found to be 34.99%. In which 4.16%, 11.25% and 19.58% of women indicate severe thinness, moderate thinness and mild thinness degree of chronic energy deficiency respectively. 11.25% of women indicate overweight and only 0.41% of women indicate obesity.

INTRODUCTION

Anthropometry offers a reliable method to assess the nutritional status of the women. It is the single most universally applicable, inexpensive and non invasive method available to assess the size, proportion and composition of human body. The physical well being and maintenance of normal health of an individual is related to his nutritional status. Life of human can not be sustained without adequate nourishment. Man needs adequate food for normal growth, development and maintenance of body tissues. Nutrition is the science that deals with the digestion, absorption and metabolism of food. Proper nutrition keeps man healthy and fit whereas inadequate nutrition reduces fitness and causes susceptibility to diseases.1 Therefore nutrition is responsible for the nutritional status of an individual. Good nutrition and malnutrition are directly linked to the nutritional status of a person. The anthropometric measurements influenced by different factors like religion, social and cultural background, customs, dietary habits and genetics influences.

Anthropometric and nutritional characteristics are related with genetics, environment, sociocultural conditions, lifestyle, health and functional status. This makes it difficult to give standard interpretation of their values. Anthropometry is an essential tool in nutritional assessment to evaluate underweight and obesity conditions which are important risk factors for severe diseases.2-3 An accurate evaluation of nutritional status should include an estimate of body measurements (Fat-free-mass and fat mass) by instrumental methods such as bioelectrical impedance analysis and dual x-ray absorptiometry.4 In clinical practice and in epidemiological surveys, body composition can be indirectly estimated by anthropometric measurements, which are non invasive, easy and inexpensive to collect data. Tribals are characterized by a distinctive culture, primitive occupation and socio economic backwardness. The tribals of India, constituting 8.2% of the total population, belong to around 698 communities. Around 75 of these groups are called primitive tribal groups due to pre agricultural level, backwardness and a dwindling population. The exact number of tribal groups may be lesser than 500 due to group overlapping in more than one state. Scheduled tribes are accorded special status under the fifth/sixth schedules of the Indian constitution, their status on the whole, especially their health still remains unsatisfactory. Tribal communities in general and primitive tribal groups in particular are highly disease prone become they do not have basic health facilities. They are most exploited, neglected and highly vulnerable to diseases with high degree of malnutrition, morbidity and mortality.5 Their misery is compounded by poverty, illiteracy, ignorance about of causes diseases, poor sanitation, lack of safe drinking water and hostile environment. Bhils constitute the third largest tribal group of India. They are also one of the largest schedule tribes of Rajasthan which constitute 44.50% of the total tribal population of Rajasthan.6 Limited data are available on anthropometric and body composition characteristics and nutritional status of tribal

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population of India.7-10 Although adult's nutritional status can be evaluated in many ways11 the body mass index (BMI) is most widely used because it's use is inexpensive, non-invasive and suitable for surveys.12 BMI is an important index in evaluating the state of health of the population. BMI was recommended as the basis for anthropometric indicators of thinness and overweight.13 The term 'underweight' in adult assessment has been applied to individuals of low body weight relating to height. BMI was found useful for the assessment of the current or short duration malnutrition among adults.14 It is used as a measure of underweight and Chronic Energy Deficiency (CED).15,16 Vary low BMI reflects low fat and fat free mass, which is typical of CED. The condition of low BMI in adults (also terms as 'thinness'), which results in CED, can be graded on the basis of BMI into mild thinness (BMI <18.49>17.0), moderate thinness (BMI <16.99>16.0) and severe thinness (BMI <16.0)BMI in the range of 18.5 to 24.99 is considered as normal and individuals above BMI of 25 are categorized as overweight. Delpeuch et al. (1994)17 reported a large prevalence of low BMI in rural areas. In general, data are scarce on the nutritional status of various tribal population of India. There are urgent needs to evaluate the most important anthropometric variables of various tribes of India therefore the objective of the present study was to evaluate the most important anthropometric variables of tribal women of Banswara district, Rajasthan (India).

Material and Method

The study was conducted in purposively selected Banswara district of Rajasthan (India). Data are collected from 240 tribal women of age group between 18 to 25 years from Talwada and Kushalgarh panchayat samiti during November 2014 to February 2015. The general information with respect to their age, caste, family type, occupation and education has been recorded for each individual before taking anthropometric measurements. Structured interviews were conducted for data collection.

Anthropometric measurements

For anthropometric measurements following methods were used:

Weight: Body weight was measured on a balance beam platform scale to the nearest 0.1 kg.

Height: Height was measured by standard anthropometric rod and approximated to the nearest 0.5 cm.

Triceps and subscapular: Triceps and subscapular skinfold was measured using skinfold caliper that exerted a constant pressure of 10 gm/mm2 over the contact surface. The triceps skinfold was taken at the posterior mid-point between the acromion and the olecranon. The subscapular skinfold was measured just to the inferior angle of the scapula. The skinfold thickness acts as a significant index of energy reserve.

Mid arm circumference, hip and waist circumference, calf circumference and thigh circumference was measured by non stretchable tape, with the subject standing position and approximated to nearest 0.1 cm.

The waist circumference was measured at the end of expiration, by wrapping the tape at the level of the umbilicus. The hip circumference was measured at the maximum posterior protrusion of the buttocks. The thigh circumference was measured at the medial point of the interior surface of the thigh.

BMI was calculated by following formula:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{weight (kg)}}{\text{height (m}^2\text{)}}$$

Mean standard deviation and % were calculated for all anthropometric variables and BMI of tribal women.

Results and Discussion

Physical measurements such as height, weight and body mass index reflect the total nutritional status over a life time. Nutritional status is also a very important indicator of accessing women health. Changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry is used the predict performance, health and survival of individuals. To assess the nutritional status various anthropometric measurements were studied namely, weight, height, triceps, subscapular skinfold thickness, mid arm circumference, waist circumference, hip circumference, thigh circumference and calf circumference. The data of the subjects has been presented in Table 1.

The mean weight of women was 49.13±7.74 kg which is 86.80% of standard value. Choudhary et al. (2003)[18] reported that the mean weight of their subjects was 37.31±8.05 kg (73.63%) of 50th percentile of NCHS values. Sachdev et al. (2005)19 found that the mean weight of the subjects was 59.2±13.4 kg. Bhardwaj and Kapoor (2007)[1] found that the mean weight of the women was 46.5±5.5 kg. Bose et al. (2005)[8] observed that the mean body weight of Bathudis tribal women was 39.8±6.2 kg. Bisai et al. (2009)[20] found that the mean weight of middle aged women was 43.2±6.4 kg. The mean height of the women was 154.73±12.44 cm which is 100% of standard value. Choudhary et al. (2003)18 found that the mean height of their respondents was 146.25±8.75 (91.98%) of 50th percentile of NCHS values. Sachdev et al. (2005)[19] observed that the mean height of the subjects was 155±0.06 cm. Bhardwaj and Kapoor (2007)[1] reported that the mean height of the women was 152.3±4.4 cm. Bose et al. (2005)[8] observed that the mean height of Bathudis tribal women was 149.2±6.7 cm. Similar results (148±5.3 cm) found by Bisai et al. (2009).20 Maiti et al. (2005)[21] observed that the mean height among both tribal and nontribal women in Jharkhand is 150 cm, which is one point less than Indian standard. The mean triceps skinfold thickness of women was 10.66±1.55 mm which is 67.46% of reference value. Sachdev et al. (2005)19 observed that the mean triceps skinfold thickness was 25.5±9.5 mm. Bose et al. (2005)8 reported that the mean triceps skinfold thickness of women was 9.1±2.4 mm an similar results (10±2.4 mm) found by Bisai et al. (2009).[20] Bhardwaj and Kapoor (2007)[1] reported that the mean triceps of women was 6.7±1.4 mm. The mean sub scapular skinfold thickness of women was 8.67±1.9 mm which is 72.85% of reference value. Sachdev et al.

(2005)[19] reported that the mean sub scapular skinfold thickness of Bathudis tribal women was 9±2.3 mm. Bisai et al. (2009)[20] observed that the mean sub scapular skinfold thickness was 11.5±2.7 mm. The mid arm circumference (MAC) is a reliable and a feasible method of assessing nutritional status of women. The mean MAC was 25.93±1.78 cm which is 97.48% of reference value. Choudhary et al. (2003)[18] reported that the mean MAC of their subjects was 20.58±2.85 (82.81%) of 50th percentile of NCHS values. Sachdev et al. (2005)19 found that the mean MAC was 26.8±4.2 cm. Bhardwaj and Kapoor (2007)1 found that the mean MAC was 20.7±1.5 cm of the study subjects. Similar results found by Bose et al. (2007)[10] and Bissai et al. (2009).[20] Waist circumference (WC) is a highly sensitive and specific measure of central adiposity and is a good way to direct risk for heart health at an early stage. The mean WC of tribal women was observed 68.63±4.94 cm which is 87.65% of reference value. Martha et al. (2010)[22] observed that WC was greater than 88 cm (78.3%). Ozenogla et al. (2009)[23] observed that normal WC was 69.41±15.44 cm, overweight WC 85.77±6.81 cm, obese WC 97.06±14.34 cm and morbid obese 117.47±11.38 cm in their study subjects. Sachdev et al. (2005)[19] reported that the average of WC was 79.6±12.4 cm of their study subjects. Bose et al. (2005)8 observed that the mean WC of Bathudis tribal women was 63.9±6.8 cm. It can be clearly seen that women were at a higher risk with regards to WC. WC regarding WHO rules24,25 the fact is that a predictive factor in abdominal obesity related conditions (high blood pressure, coronary heart disease, type II diabetes, vascular cerebrals accidents). The mean hip Circumference (HC) of tribal women was 83.61±4.55 cm which is 95.01% of reference value. Oladipo et al. (2012)[26] observed that the females have higher value in the mean (96.54 cm) of HC. Ozenogla et al. (2009)23 observed that normal HC was 95.68±5.44 cm, overweight HC 108.58±19.78 cm of their study subjects. Sachdev et al. (2005)19 observed that the mean HC was 97±10.4 cm of their study subjects. Bose et al. (2005)[8] reported that the mean HC of Bathudis tribal women was 78.5±5.7 cm. Bisai et al. (2009)20 found that the mean HC of middle aged women was 81.3±5.6 cm. The mean thigh circumference (TC) of women was 41.10±2.18 cm which is 89.93% of reference value. Bisai et al. (2009)20 observed that the mean TC of middle age women was 36.5±3.8 cm. The mean Calf Circumference (CC) of tribal women was 29.22±2.34 cm which is 86.44 of reference value. Bose et al. (2005)[8] reported that the mean CC of women was 27.6±3.2 cm. Bisai et al. (2009)[20] found that the mean CC of women was 27.7±2.5 cm. Bhardwaj and Kapoor (2007)[1] reported that the mean CC of women was 26.2±1.6 cm. The mean anthropometric measurements of the subjects were lower than reference values. Parve et al. (2015)[27] found that the mean body circumference measurements of abdomen 100.34 cm, arm 27.16 cm, chest 88.03 cm, waist 80.93 cm and hip circumference was 93.66 cm respectively.

The findings revealed that the tribal women were living in a state of great deprivation due to poor socio-economic status. Various anthropometric measurements like stature, body weight, upper arm circumference, calf circumference, biceps skinfold thickness and triceps skinfold thickness showed tendency to increase up to middle age followed by decline. The decrease in latter age groups is more marked. This age related phenomena displayed by various body measurements reflect the impact of aging process. It seems to be a universal phenomenon despite the differences in socioeconomic status.28,29 The decrease in height with age seems to be universal and inevitable age related change. A loss of collagen between spinal vertebrae causes the spine to bow and the height to shrink leading to a decrease as much as 3 inches.30 The decline body weight may be attributed to the decrease in muscle mass in response to reduced amount of protein intake as well as decline in number and size of muscle fibers due to degenerated diseases associated with the advancing age. It may partly be due to bones becoming lighter because of gradual mineral mass loss.31

The decline in skinfold thickness at a biceps and triceps may be attributed to decrease in subcutaneous fat as a result of reduced energy intake, as fat content is dependent on nutrition intake and energy expenditure of the individual concerned.32 Upper arm circumference and calf circumference showed more or less similar pattern of decreasing trend with advancing age. This decline with age is indicative of the reduced lean body mass. The loss of lean tissues with age has been substantiated in the longitudinal study by Tzankoff and Narris (1977)33 who have shown decline in the basal metabolism with age indicating loss of muscle mass.

Difference of BMI values of women were shown in Table 2. As there were adequate number of women (240) of different age group (18 to 25 yrs) on whom anthropometric data were collected within each of the stratum and then different grades of BMI were calculated. At the aggregate level, 53.33% of women shown normal range of BMI value (18.5 – 24.9). 4.16%, 11.25% and 19.58% women indicate severe thinness (<16.0), moderate thinness (16.0 – 16.9) and mild thinness (17.0 – 18.5) degree of chronic energy deficiency. 11.25% of women indicate overweight (25.0-29.9). Only 0.41% of women indicate obesity (>30.0). Oladipo et al. (2012)26 the females showed of underweight (2.8%) and normal (60.4%) of BMI categories. The females who had 22.8% and 14% for overweight and obese respectively. Maiti et al. (2005)21 observed that the mean BMI of for tribal women in Jharkhand is 19.1 compared to 19.5 among the non tribal women. More than half of the women have a BMI between 18.5-25 kg/m2 (normal condition), still about 41% of both tribal and non tribal women in Jharkhand have a BMI of less than 18.5 kg/m2 which indicates a high prevalence of chronic nutritional deficiencies.

Manisha et al. (2000)34 reported that deviations on both sides of BMI (thinness and obesity) lead to a greater load morbidity resulting in reduced health expectancy which are taxing to the families, society and the whole nation in terms of money, care, manpower and resources. Shah et al. (1989)35 identified various socio–demographic variables as correlates of BMI. 3.33% and 41.66% of the study subjects suffered from CED II and CED III, which reflects a high degree of nutritional deficiency in women. This indicates a great risk and a high prevalence of undernutrition in the women. This may be due to the undernutrition, which is highly rampant in the lower strata of the society. Parve et al. (2015)27 observed that majority of the selected women 57.5% overweight, 15% obesity and 27.5% women were underweight. Singh et al. (2013)36 reported that the mean body mass index was in the range of optimal health and

value of 5th percentile was found to be in the range of the severe chronic energy deficiency grade III (29.3%), obese 24.7% and overweight 8.7%. Sina et al. (2015)37 showed an increased risk of gestational diabetes mellitus with increase in one standard deviation of BMI, weight, waist circumference and high BMI was associated with subsequent gestational diabetes mellitus.

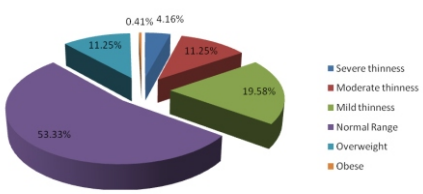
Table 1: Comparison of Anthropometric measurement of women (N=240) with Standard values of NCHS.

Variables	Standard	Mean	SD	%
Weight (kg)	56.6	49.13	7.74	86.80
Height(cm)	154.7	154.73	12.44	100
Triceps (mm)	15.8	10.66	1.55	67.46
Sub-Scapular (mm)	11.9	8.67	1.90	72.85
Mid-arm-circumference (cm)	26.6	25.93	1.78	83.37
Waist-Circumference (cm)	78.3	68.63	4.94	87.65
Hip Circumference (cm)	88.0	83.61	4.55	95.01
Thigh Circumference (cm)	45.7	41.10	2.18	89.93
Calf Circumference (cm)	33.8	29.22	2.34	86.44

Table 2: Body mass index of women (N-240) according to WHO standard in different categories.

Grading of BMI	WHO standard	No.	%
Severe thinness	<16.0	10	4.16
Moderate thinness	16.0-16.9	27	11.25
Mild thinness	17.0-18.4	47	19.58
Normal Range	18.5-24.9	128	53.33
Overweight	25.0-29.9	27	11.25
Obese	>30.0	01	0.41

Fig. 1: Body mass index of women.



Conclusions

Present study provides to evaluate the most important anthropometric variables of the tribal women (18-25 years) of Banswara district, Rajasthan (India). Appraisal of nutritional status adjusted by the weight, height, triceps and subscapular skinfold thickness, mid arm circumference, hip and waist circumference, thigh circumference and calf circumference revealed that the median parameters of the women were comparable to the NCHS standards. Calculating BMI proves a simple method and correct assessment of the degree of thinness.

The results of the present study indicated that the prevalence of undernutrition among tribal women was high. Most importantly, immediate nutritional intervention programs are needed for implementation for this tribal population and to improve nutritional status of women health education and nutritional counseling are also needful. The high rate of undernutrition among tribal women could have severe health implications. On comparison of the mean values of the anthropometric variables and BMI of tribal women of the present study with those calculated from the standards of NCHS,38 it can be seen that the mean values of the present study tribal women falls much below these International Standards.

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