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Original Research Article

Status of Certain Anthropometric Parameters of Males of Sasaram, India and Its Variation due to Soybean Added Diet

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ABSTRACT

The anthropometric parameters are regarded as sensitive indicators. The core elements of anthropometric parameters are bodyweight, height and body mass index. To assess certain anthropometric features of males of Sasaram in respect to the standards and the variations in these features due to 60 days feeding of soybean added diet was the purpose of the work. Experimental studies indicate that soybean added diet might facilitate loss of bodyweight. All subjects were observed for anthropometric measurements after feeding of routine diet and soybean added diet. The average bodyweight was 63.65±8.97 kg of volunteers aged 20-59 years with a height of 162.0+6.0 cm in controlled condition among 2127 males. The average height of volunteers of 162.0+6.0 cm was found less than the present standard of the Bihar, India as well as the world. On the other hand, the average of body mass index was 24.88±3.01 kg/m^2 among the volunteers of the above age group and was found less than the present standard of the world but more than the standard of India. Consumption of soybean added diet was related to a moderately significant decreased weight ($p<0.01$) and body mass index. The study helps in establishing the anthropometric features of people of this area in comparison to the standard of the state and the country.

Key Words: Bodyweight, Body mass index, Males, Sasaram, Soybean diet.

INTRODUCTION

It has been well established that anthropometric parameters are the essential tools for determining nutritional status, assessment of the people growth and development for their optimal results (1). The body mass index or BMI seems a measuring scale of general physic and is based on height and weight ratio. The concept of body mass index was devised by Quetelet (2). It provides a reliable metric of body fatness for most people and is used to screen for weight categories (3). Body mass index changes throughout growth and development. It can be used as an indicator for tracking body size throughout the life cycle. Diet plays a very important role in weight loss and gain, and can, thus, directly affect your BMI. Therefore, because of global application to accept identification of particular categories of body mass as a health concern, it has been useful in population-based studies.

While some factors like height are not under one's control, factors like diet and healthy eating can be controlled. If one eats a healthy, balanced diet, they are likely to lose weight and fall in the healthy BMI range (4). Developing countries like India are facing multiple risk and adverse impacts of obesity because of intake of energy dense food, sedentary and passive life style, wanting of facilities of health care and monetary help (5). Soy is obviously selected as an item of diet change or dietary component related to weight loss because of its low cholesterol and high protein proportion [6]. Cross-sectional studies stress the relation of soy with lower body weight, in addition to many animal studies. Genistein consumption, as for example, was negatively correlated with BMI [7].

One of the agricultural states situated in the eastern part of India is Bihar. It consistently ranks poorly on a number of growth and health-related metrics with almost 10% of India's population [8]. The accessibility of health facilities is very poor and due to dire poverty. The Rohtas district is a part of the Patna Division of Bihar. The administrative headquarters of the district, Sasaram is a place of historical importance and is popularly known as the "bowl of rice. The area is highly fertile and due to this is densely populated with 247,408 individuals. It is known for the production of cement, fertilizers, stone chips, and the quarrying industry.

In this context, the present work is an attempt to assess critically certain anthropometric parameters and their variation due to the effect of soybean added food amongst adult males at Sasaram. The information will support policy-maker, plan of diet preparation and focusing reliable data that is intended for usage.

MATERIALS AND METHODS

Collection of Data

The work was based on information collected from 2127 of males aged 20-59 years from the Sasaram district of Bihar from January 2019 to December 2019. Data were collected by trained technicians of Kumar Janch Ghar (A Pathology and Clinical Centre), Sasaram.

Nutrient Composition

The nutrient composition of the routine diet was recorded to be 8.46±8.24% of nutrients, 1.09±0.58% of amino acids, 0.75±0.41% and 52.59±56.47mg/kg of minerals. To estimate soy exposure a questionnaire was prepared after a questionnaire of validated soy (Williams et al., 2003). The soybean added diet contained approximately 75.77±99.43µg/g (Daidzin: 198.2 and Genistein: 286.1) phytoestrogens while the phytoestrogen content in the routine diet was below the limits of HPLC detection.

Measurement of Anthropometric Parameters

The height of volunteer was taken thrice standing upright and motionless in the horizontal plane employing a portable stadiometer (Galaxy 214).

The body weight of volunteer wearing light clothing and bare feet was determined also thrice with an electronic digital weighing machine (HD-93).

BMI was calculated by dividing the weight of a volunteer the square of his/her height.

$$\mathbf{BMI} = \frac{\textbf{Weight in kilogram}}{\textbf{Height in meter}^{2}}$$

Statistical Analysis

The data were presented as means and standard deviations. ANOVA was applied to evaluate the effect of soy added diet on BMI applying Excel and SPSS software packages.

OBSERVATIONS AND RESULTS

Height, Body Weight and BMI of Control Group

The average height of 2127 volunteers aged 20-59 years was 1.62 + 0.06 m and showed an inverse and weak relationship ($r = 0.674$, $p > 0.05$) to age.

$$\mathbf{y = 1.635 - 0.000x}$$

The mean body weight of 63.65 ± 8.97 kg ranged from 56.89 ± 6.60 to 67.5 ± 12.08 kg among the volunteers indicated an non-significant positive correlation ($r = 0.779$, $p > 0.05$) with age.

$$\mathbf{y = 53.82 + 0.280x}$$

The range of BMI was 22.87 ± 2.43 to 26.16 ±3.14 kg/m2 with an average of 24.88 ± 3.01 kg/m2 among the volunteers of the above age group to show an non-significant positive correlation ($r = 0.766$, $p > 0.05$) (Table I).

$$\mathbf{y = 21.95 + 0.083x}$$

Table 1: Relationship between age and body weight, height and body mass index of males of age group 20-59 years as a control group

Age Group (years)	Number of participants	Height (meter)		Body Weight (kg)		Body Mass Index (kg/m^2)	
		Observed	**Standard**	**Observed**	**Standard***	**Observed**	**Standard**
20-29	584	1.63 ± 0.05 [1.6392]	-0.14	56.89 ± 6.60 [65.9349]	58.6 ± 5.9	22.87 ± 2.43 [24.5482]	Normal (18.5-23.0)
30-39	649	1.61 ± 0.06 [1.6214]	-0.16	64.85 ± 8.33 [63.4936]	55.5 ± 4.6	25.19 ± 3.06 [24.5095]	Obese (25.0-30.0)
40-49	670	1.62 ± 0.06 [1.6037]	-0.15	67.5 ± 12.08 [61.0523]	58.6 ± 5.9	26.16 ± 3.14 [24.4709]	Obese (25.0-30.0)
50-59	224	1.61 ± 0.05 [1.5859]	-0.16	65.37 ± 8.86 [58.6109]	55.5 ± 4.6	25.34 ± 3.41 [24.4322]	Obese (25.0-30.0)
20-59	2127	1.62 ± 0.06 [1.61]	-0.15	63.65 ± 8.97 [62.27]	57.1 ± 1.55	24.88 ± 3.01 [24.49]	Overweight (23.0-24.9)
ICMR-NIN (2020) recommended average for Indian Males			1.77m*		65kg		18.5-23.0 kg/m^2 (Normal)

Somasundaram K (2020): Height Weight Chart: Ideal Weight for men and Women

Effect of Soybean added Diet on Body Weight

The bodyweight of 1060 volunteers was found more in the routine diet group but was less in the soybean added diet. A bit hyperbolic variation because of the feeding of soybean added diet was more with the increase of age.

The bodyweight of volunteers of age group 20-59 years after 60 days feeding of routine diet ranged from 57.95 ± 7.68 to 70.56 ± 8.91 kg. The range of bodyweight gave an non-significant positive correlation ($r = 0.789$, $p > 0.05$) to the age.

$$y = 54.11 + 0.359x$$

On the other hand, after 60 days feeding of soybean added diet to 1067 volunteers, the range of body weight was 53.44 ± 6.96 to 63.23±7.85 kg. A non-significant direct correlation ($r = 0.708$, $p > 0.05$) exists with the age.

$$y = 51.44 + 0.241x$$

ANOVA inferred that both the type of feeding of diet and age group have a moderately significant ($p < 0.01$) effect on the bodyweight of volunteers in both the groups (Table 2).

Table 2: Variation in body mass index of males of age group 20-59 years after 60 days feeding of routine diet and soybean added diet

Age Group (years)	Type of diet	Number of participants	Weight (kg)	Height (meter)	Body Mass Index (kg/m^2)		
					Observed	**Standard According to**	
						(ISC, 2008)	**(WHO, 2003)**
20-29	Routine diet	290	57.95 ± 7.68	1.63 ± 0.05	22.08 ± 3.06	Normal (18.5-23.0)	Normal (18.5-23.0)
	Soybean added diet	294	53.44 ± 6.96 [-7.78%]	1.63 ± 0.05 [0%]	20.11 ± 2.78 [-8.92%]	Normal (18.5-23.0)	Normal (18.5-23.0)
30-39	Routine diet	325	68.89 ± 10.47	1.61 ± 0.06	26.58 ± 2.91	Obese (25.0-30.0)	Pre-obese (25.0-30.0)
	Soybean added diet	324	61.85 ± 12.61 [-10.22%]	1.61 ± 0.06 [0%]	23.86 ± 3.50 [-10.23%]	Overweight (23.0-24.9)	Normal (23.0-24.9)
40-49	Routine diet	335	70.56 ± 8.91	1.62 ± 0.06	26.87± 2.47	Obese (25.0-30.0)	Pre-obese (25.0-30.0)
	Soybean added diet	335	63.23 ± 7.85 [-10.39%]	1.62 ± 0.06 [0%]	24.09± 2.18 [-10.35%]	Overweight (23.0-24.9)	Normal (23.0-24.9)
50-59	Routine diet	110	69.37 ± 10.69	1.61 ± 0.05	26.76 ± 4.28	Obese (25.0-30.0)	Pre-obese (25.0-30.0)
	Soybean added diet	114	61.02 ± 11.62 [-12.04%]	1.61 ± 0.05 [0%]	23.54 ± 4.65 [-12.03%]	Overweight (23.0-24.9)	Normal (23.0-24.9)
20-59	Routine diet	1060	66.69 ± 9.44	1.618 ± 0.055	25.57 ± 3.18	Obese (25.0-30.0)	Pre-obese (25.0-30.0)
	Soybean added diet	1067	59.88 ± 10.47 [-10.21%]	1.618 ± 0.055 [0%]	22.90 ± 3.278 [-10.44%]	Normal (18.5-23.0)	Normal (18.5-23.0)
			ANOVA (C_{df1}=69.64**; R_{df3}=39.39**)		ANOVA (C_{df1}=60.90**; R_{df3}=33.22**)		

Effect of Soybean added Diet on BMI

The BMI of 1060 volunteers was more in routine diet group but was less in the soybean added diet. The hyperbolic variation because of the feeding of soybean added diet was more with an increase of age.

The BMI of volunteers of 20-59 years after feeding of routine diet for 60 days ranged from 22.08 ± 3.06 to 26.76 ± 4.28 kg/m^2. The dispersion of body mass index gave a weak relationship ($r = 0.793$, $p > 0.05$) with age.

$$\mathbf{y = 21.99 + 0.143x}$$

On the other hand, feeding of soybean fortified diet for 60 days to 1067 volunteers; the dispersion of BMI was 20.11 ± 2.78 to 23.58 ± 4.65 kg/m^2. A weak relationship ($r = 0.725$, $p > 0.05$) exists with age.

$$\mathbf{y = 20.27 + 0.105x}$$

Multivariate analysis inferred that each kind of feeding of diet and volunteers have moderately significant ($p < 0.01$) impact on the BMI of volunteers in each groups (Table 2).

DISCUSSION

Environmental parameters act as important features dispiriting in fitness and growth of individuals [9]. It may be counseled that growth parameters be updated frequently based on the temporal pattern of growth in a population [10]. In India, a profane trend in anthropometrical parameters is obvious over last 30-40 years [11]. Over the last 4-5 decades, there has been a rise in body mass index in common population. This has resulted in predictions of a public health catastrophe forecasts.

Table-3: Standard Height of men at 20 years (cm) cm increase/decrease per decade population (Census, 2001 and 2011)

Country / State	Population (by 2019)	Height	Change per decade (cm)	Country / State	Population (by 2019)	Height	Change per decade (cm)
India	139.77 crore	166.3± 2.585 (157.2-168.6)	0.403 ± .529 (-1.16 to 1.31)	Jammu & Kashmir	1.25 crore	168.3	+1.09
Dinaric Alps	5547	185.6	-	Meghalaya	26.5 lakh	157.2	-0.57
Indonesia	27.06 crore	158.0		Bihar	9.9 crore	163.8	+0.40
World average	767.35 crore	169.97					

The height of males ranged from 158.0 cm in Indonesia to 185.6 cm in Dinaric Alps with a world average of 169.97 cm (Table: 3). ICMR- NIN [12] has revised the heights for Indian men to 177.0 cm. The average height of a male of Bihar state is 164.6 cm and increasing with the rate of 0.48 cm per decade [8]. The average height of volunteers of 162.0+6.0 cm of Sasaram in this work was found less than the present standard of the state, country as well as world. Determination of height not only based on eating patterns, socioeconomic factors and demographic features, but also on genetic structure and environmental conditions. Therefore the change in height seems to be least within a particular group of individuals; on the other hand, body weight of individuals on several biotic and abiotic factors [13].

The ICMR-NIN [12] also revised the average weight for Indian men with regard to age to 20-39 years were 65kg. Therefore, the mean body weight of 63.65±8.97 kg of volunteers of Sasaram was less compared to the latest Indian standard. The average body weight of 66.69+9.44 kg of volunteers of age-group 20-59 years was found more in the routine diet group but was 59.88 + 10.47 kg and less after 60 days feeding of soybean added diet. A meta-analysis report of Mu et al., [14] confirmed that certain products of soy significantly ($p<0.05$) declined body weight of Asian populations (−0.37 kg).

An indicator of living standards on nutritional standing may be expressed through the BMI [15] and has been correlated with socioeconomic factors in various developed as well as developing nations [3]. WHO expert group [16], proposed BMI based criterion 23.0–24.9 and ≥25 kg/m2 respectively for overweight and obese people residing in the Asia-Pacific nations. Men either overweight or obese are a total of 12.6% (10.9-20.1%) in Bihar based on >25.0kg/m^2 scale (Table: 4). The average

BMI among the volunteers was of 24.88±3.01 kg/m^2, indicating the overweight category of individuals of Sasaram. The variation of BMI is thus very high due to variation in weight [17].

Table 4: Classification of Body Mass Index categories as per the WHO (2003) and ISC (2008)

Sl.No.	Classification	BMI (kg/m^2) (WHO)	BMI (kg/m^2) (ISC)	Sl.No.	Classification	BMI (kg/m^2) (WHO)	BMI (kg/m^2)(ISC)
1.	Underweight	< 18.50	< 18.50	4.	Pre-obese	25.00 – 29.99	24.00 – 24.99
	Underweight	< 16.00	< 16.00	5.	Obese	≥ 30.00	≥ 25.00
	Severe thinness	16.00 – 16.99	16.00 – 16.99		a. Obese Class I	30.00 – 34.99	25.00 – 29.99
	Mild thinness	17.00 – 18.49	17.00 – 17.49		b. Obese Class II (Obese morbidly)	35.00 – 39.99	30.00 – 34.99
2.	Normal Range (Healthy)	18.50 – 24.99	18.50 – 22.99		c. Obese Class III (Obese morbidly)	≥ 40.00	≥ 35.00
3.	Overweight	≥ 25.00	≥ 23.00				

Table 5: Data published by the World Health Organization (WHO, 2015)

Country	Rank	Mean BMI (kg/m^2)	Male rank	Male mean BMI (kg/m^2)	Country	Rank	Mean BMI (kg/m^2)	Male rank	Male mean BMI (kg/m^2)
Nauru	1	32.5	1	32.1	Eritrea	190	20.5	190	20.1
India	178	21.9	172	21.8					

The BMI of males ranged from 32.1kg/m^2 in Nauru to 20.1kg/m^2 in Eritrea with a world average of 26.1kg/m^2 (WHO, 16) but 21.8kg/m^2 in India (Table-5). The average BMI of 25.57+3.18kg/m^2 of volunteers was more in the routine diet group but was 22.90+3.278 kg/m^2 and less in the soybean added diet. The average BMI of volunteers in this work was found less than the present standard of the world but more than the standard of the country. A meta-analysis report of Mu et al., [14] confirmed that soy products significantly ($p<0.05$) reduced BMI of Asian populations (−0.27kg/m^2). Furthermore, Yamori [18] observed that feeding of fish in Japan was related to low BMI as soy feeding.

Garrow and Webster [19] explained that by using regression, a BMI of 16.9 in men represents total absence storage of body fat. The present observation indicates that volunteers in both conditions possess fat as their regression was 21.99 and 20.27 respectively.

Because soy intake was related to consumption of vegetable low BMI in the high soy feeding group is also an outcome of healthy lifestyles and feeding behaviours instead of an immediate effect of soy foods. During this context, Maskarinec et al., [20] discovered that eating additional soy foods in active people expected low BMI and low annual weight gain since age 21 for Caucasians and, to a lesser degree, for Japanese. Intake of soy during early life was not related to body mass index at age 21 or throughout adulthood. Moreover, Yamori [18] fish intake in a work in Japan was related to low BMI similar to consumption of soy. An inverse association between soy food intake that remained vital once accounting for age and BMI of men was conjointly investigated by Chavarro et al., [21].

CONCLUSIONS

The observations infer that males of Sasaram possess less height, less body weight and less BMI compared to ICMR-NIN [12] standards. The results also suggest that men consuming more soy foods during active life have comparatively low BMI than other people of the city. The information will support policy-maker, plan of diet preparation and focusing reliable data that is intended for usage.

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Conflict of Interests

Authors have no personal, academic, financial, commercial or political competing interests exist.

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